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ABSTRACT

This issue of ENC Focus focuses on the topic of inquiry and problem solving. Featured articles include: (1) "Inquiry in the Everyday World of Schools" (Ronald D. Anderson); (2) "In the Cascade Reservoir Restoration Project Students Tackle Real-World Problems" (Clint Kennedy with Advanced Biology Students from Cascade High School); (3) "Project Snoop Troop Cultivates a Community of Learners" (Julia Harris); (4) "Petals Around the Rose: Building Positive Attitudes about Problem Solving" (Marie Appleby); (5) "Roll with It: An Activity Integrating Mathematics and Science" (Bill Heinmiller); (6) "Inquiring Minds Find New Challenges in Mathematics Competitions, Contests, and Events" (Terese Herrera, Leah Poynter, and Judy Spicer); (7) "Walter Wick's Tricks Engage Young Minds, and Selecting Books? NSTA Provides Guidance" (Annette Thorson); (8) "20 Ways to Foster Creativity in Your Students" (Laura C. Mohr); (9) "'Students Questioning Students' Leads to Better Learning" (Judith Engel with Mathematics Students at The Bronx High School of Science); and (10) "Classroom Resources for Inquiry and Problem Solving" (Terese Herrera and Kimberly S. Roempler). Educational news, editorials, essays, classroom stories, and columns on topics of interest to classroom innovators are also included. (WRM)

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vol. 6, no. 2, 1999

focus

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INQUIRY AND PROBLEM SOLVING

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contents

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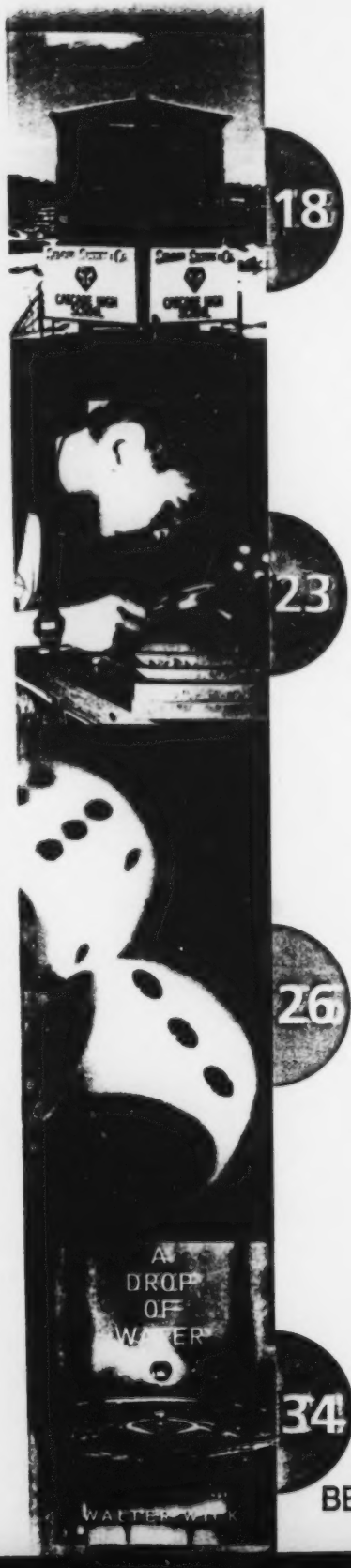
Theme for this Issue: Inquiry and Problem Solving



UPDATE

Update: Around the Clearinghouse and the Nation

This section features educational news, editorials, essays, classroom stories, columns on topics of interest to classroom innovators, and other information of the sort formerly published in our newsletter *ENC Update*.

4 Editorial: *Who Are Classroom Innovators?*
by Annette Thorson

Calling All Classroom Innovators: Write for ENC!
Turn here for information on future topics and on how teachers and students can contribute to this publication.

Innovators' Forum Online
Participate in ENC's electronic discussion for all those interested in educational improvement.

6 ENC's Partners: *The Math Forum*
by Leah Poynter
This column features organizations that collaborate with ENC.

8 ***Eisenhower Regional Consortia and ENC Demonstration Sites***
Complete contact information for ENC's primary partners.

10 America Counts
by Wendy Goldstein
Building on the success of America Reads, government agencies partner to improve mathematics education.

11 Using the Internet in the Classroom: ***Getting What You Want from the Web***
by Kimberly S. Roempler
In every issue, ENC's Associate Director of Instructional Resources writes about her experiences introducing science students to the Internet.

13 Going for Grants: *Corporate Foundations*
by Tracy Crow
Check this regular column for information about finding and applying for money to support innovative projects in mathematics and science education.

15 ENC in Action
Teacher Research Begins with ENC Online
by Blake West
This Kansas teacher put ENC Online at the top of his list of resources for colleagues researching a new mathematics curriculum. Join them by visiting

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Focus On: Inquiry and Problem Solving

This section presents articles on the theme of this issue.

16 Inquiry in the Everyday World of Schools
by Ronald D. Anderson
A member of ENC's Science Advisory Board takes a closer look at the meaning of inquiry.

18 In the Cascade Reservoir Restoration Project Students Tackle Real-World Problems
by Clint Kennedy, with Advanced Biology Students from Cascade High School
Water quality issues engage students in a small high school in Idaho.

23 Project Snoop Troop Cultivates a Community of Learners
by Julia Harris
Parents, teachers, and community members work together to bring excitement to learning math and science in a K-3 school.

26 Petals Around the Rose: Building Positive Attitudes about Problem Solving
by Marie Appleby
Middle school students take charge of their own learning once this math teacher presents an intriguing puzzle.

30 Roll with It: An Activity Integrating Mathematics and Science
by Bill Heinmiller
Model cars jump start student interest in investigating laws of motion.

32 Inquiring Minds Find New Challenges in Mathematics Competitions, Contests, and Events
by Terese Herrera, Leah Poynter, and Judy Spicer
By involving students in fun, exciting, and challenging experiences, teachers can inspire a zeal for learning and exploration.

34 Walter Wick's Tricks Engage Young Minds and Selecting Books? NSTA Provides Guidance
by Annette Thorson
These two articles provide advice for teachers looking for outstanding materials to use in science class.

36 20 Ways to Foster Creativity in Your Students
by Laura C. Mohr
Diverse thinking is essential for real inquiry and problem solving. Here are a few classroom tips on how to encourage it.

38 "Students Questioning Students" Leads to Better Learning
by Judith Engel, with Mathematics Students from The Bronx High School of Science
A veteran mathematics teacher and three of her former students describe how Socratic questioning provides cognitive and affective education.

Focus On: The ENC Collection

40 Classroom Resources for Inquiry and Problem Solving
by Terese Herrera and Kimberly S. Roempler
ENC's mathematics and science content specialists explain their process for choosing materials for this section.

42 Searching ENC's Collection of Resources

43 Resource List
Professional Development
Instructional Materials
Construction Sets
Sources of Good Problems
Technology Tools for Exploration
Competitions

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update:

Who Are Classroom Innovators?

by Annette Thorson, ENC Publishing

Welcome to the second issue of *ENC Focus: A Magazine for Classroom Innovators.* It has been an exciting challenge to create this new publication by combining our newsletter, *ENC Update,* with the "old" *ENC Focus,* which was originally a mini catalog of resources from the ENC Collection.

Along the way, we have grappled with a number of issues, among them the title of the new magazine. We were asked, "Just what do you mean by classroom innovators?" From our point of view, it was more important to know what others think it means. So we asked a number of teachers and other educators, "What does 'classroom innovators' mean to you?"

Most responses were positive. One person saw classroom innovators as "educators who move their curriculum forward to meet the ever-changing needs of students." Other people expressed a high level of excitement: "I like being creative. . . . This title leads me to believe that in this magazine I will find the thoughts of people who are like me—risk takers. . .people who dare to dream." Another wrote, "The publication is aimed at teachers on the cutting edge, the visionaries that students clamor for."

A few people expressed reservations. "It sounds like a publication for exceptional teachers, not ordinary teachers." And, "I am not sure many teachers see themselves as innovators." Such sentiments let us know that we could not ignore the research profiling the kinds of people who choose to be K-12 teachers (Cruickshank, 1990). For the most part, they are hardworking, modest, and unselfish; their inten-

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tion is to serve their students and society. Such people may hesitate to claim that they themselves are visionaries or cutting edge or risk takers—or innovators.

By the same token, K-12 teachers would be the first to say that there are no "ordinary" students; to them we reply there are no "ordinary" teachers. Anyone who listens and responds to young people, who tries a new way to help a child learn, is a classroom innovator.

Perhaps Laura Mohr, a first-year teacher in Missouri who wrote the article "20 Ways to Foster Creativity in Your Students" (see page 36) touches on the core of the issue when she states, "I wrote this list to exemplify an ideal that I have been striving for but have not yet achieved."

Classroom innovators are not those who have arrived—who would claim that, anyway?—but those who strive.

We think this issue's theme, Inquiry and Problem Solving, is compelling for educators who fit that definition of classroom innovator. To approach this topic, we turned to working classroom teachers who could write about the challenges and joys they face daily. You will meet Clint Kennedy, a biology teacher in Idaho, whose students found that real-world science sometimes means understanding sewage (page 18). Marie Appleby, a middle-school math teacher in Massachusetts, describes pushing her students to the "ah-ha!" moment (page 26).

What innovation means in everyday classrooms is embedded in each article. In his description of an activity in which students inquire into the laws of motion, veteran physics teacher Bill Heinmiller states it clearly: "Every time I do this activity, my students make a new request." (See page 30.)

We hope to continue to publish articles from people—like you—who know what real classroom innovation is all about. See the sidebar on this page for details on how you can contribute. ●

Cruickshank, Donald R. (1990). *Research that Informs Teachers and Teacher Educators.* Bloomington, IN: Phi Delta Kappa.

WRITE FOR ENC!

ENC invites readers to contribute articles for upcoming issues of *ENC Focus: A Magazine for Classroom Innovators.*

Topics and Deadlines:

Assessment in Science and Mathematics
Submissions due September 1, 1999

Math and Science in the Real World
Submissions due December 1, 1999

Educational Equity
Submissions due March 1, 2000

Topics and deadlines subject to change without notice.

Submission Guidelines:

Articles should be of interest to teachers of K-12 mathematics and science. Content should be grounded in the new educational standards while being short (500 to 2000 words) and compelling.

We particularly invite teachers to write about their classroom experiences, using first person and a conversational tone. Please note that library research papers written in academic language for graduate school courses are unlikely to be selected for publication. We do, however, encourage you to include a few, carefully selected references. All content must be original, and all quotations must be properly cited.

We also publish essays by K-12 students about their successes in mathematics and science. Teachers are encouraged to assist students in writing and submitting materials for publication.

Photos or other illustrations add interest, and good illustrations increase your chances for publication. However, we can use photos of students only if we receive written parental permission for those under 18 years of age.

Those considering submission of unsolicited manuscripts are encouraged to send a proposal via e-mail:

athorson@enc.org

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HELP CHOOSE TOPICS

What would you like ENC Focus to address in upcoming issues?

Send your suggestions to: editor@enc.org
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Innovators' Forum Online

While no one has answers for all the issues facing educators today, progress is possible when classroom innovators, like yourself, exchange ideas.

To make such an exchange possible, the online version of *ENC Focus: A Magazine for Classroom Innovators* http://www.enc.org/focus/ features an electronic Innovators' Forum. Readers are invited to send concerns and comments via e-mail to editor@enc.org. Selected messages will be published online, and of those, a few will appear here, so that readers of the print version of the magazine can participate.

To get the Forum rolling, here is one e-mail message sent in response to a recent request that administrators share their school's most pressing problems. Since the theme of the next issue of *ENC Focus* is Integrating Technology in the Classroom, we have chosen a message on that topic. We invite you to respond or to send a message on another topic of concern to you.

Dear Innovators,
We made a technology plan for the entire school (Montessori Pre-K, elementary, and high school); now our problem is getting all the teachers to use the computers. One of the problems is that the more experienced teachers never used a computer before. The other problem is to utilize the computers in ways that aren't just busy work or rewards for finishing early.

Our teachers would benefit from information about how others are using technology in the classroom in the form of lessons and practical activities.

Pat Pietruszka, Math Teacher and Technology Coordinator
Nardin Academy, Buffalo, New York

Please keep in mind that Innovators Forum offers a way for you to discuss issues with other classroom innovators. You can get information and answers to many educational questions from ENC's Information Services Department. Contact them by e-mail library@enc.org or telephone (614) 292-9734.

When you contribute to Innovators' Forum, please include your full name, your title or the grade you teach, the name of your school or district, and your city and state. Please note that comments selected for publication may be edited for brevity and clarity and that by submitting them you are giving permission for your comments to appear in both the print and the online versions of this publication.

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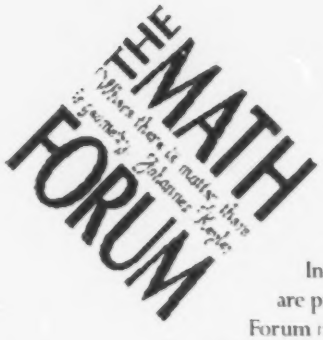
ENC's Partners

The Math Forum

In each issue, *ENC Focus* features one of the many organizations that collaborate with ENC to promote educational improvement. In this issue, we take a look at the Math Forum, a nationally recognized Internet resource for math students and educators.

by Leah Poynter, ENC Publishing

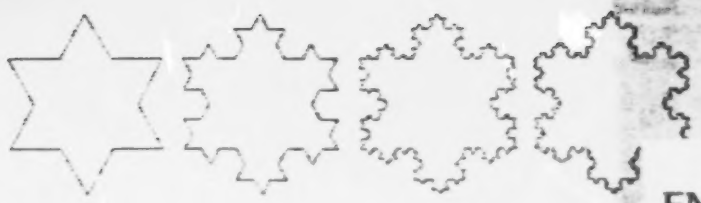


If you look forward to ENC Online's Digital Dozen feature, which highlights 13 outstanding math and science Internet sites each month, then you are probably well aware that the Math Forum http://forum.swarthmore.edu/ is one of ENC's most impressive friends and partners. Since September 1995, this online math education community has won 11 ENC Digital Dozen awards.

Formerly known as the Geometry Forum, the Math Forum is built on the activity of the teachers, students, researchers, and parents who use it. No one knows better how well this formula works than the thousands of students and teachers who tackle the Problems of the Week (POWs) on a regular basis. POWs provide a creative mathematical challenge that can be used in the classroom or at home. New problems are offered each week for elementary, middle school, algebra, geometry, and trigonometry and calculus students. In Internet terms, the Geometry Problem of the Week is ancient! This part of the project was launched in December, 1993.

Today's Math Forum Problems of the Week rely on volunteer mentors who reply to the hundreds of solutions sent in by students. Mentors and students communicate back and forth, discussing their problem-solving techniques. Math Forum mentors include a wide range of experts—from college professors, preservice teachers, and retirees to classes of high school, middle school, and elementary students who work with their teachers to mentor other students.

The Math Forum hosts a number of other interactive projects such as Ask Dr. Math, a question-and-answer service for K-12 math students and teachers, and Teacher2Teacher (T2T), for questions about pedagogy, curriculum, and other teaching issues. T2T questions are answered by a panel of Presidential Awardees for Excellence in Mathematics Teaching. Teachers can browse through the archive of T2T answers and participate in public discussions surrounding these issues.



The site houses an abundance of math and math education content in the Forum Web Units and Lessons section. Many of these resources have been developed by teachers, and several Web units have won ENC Digital Dozen awards. (See the sidebar on this page.)

The Math Forum also tries to provide the greatest possible coverage of math and math education Web sites as well as serving as a gateway to public domain and shareware software. Ample opportunity to communicate with colleagues is provided through the Math Forum's collection of mailing lists and Web-based discussion areas.

A number of new projects are under development at the Math Forum. Staff members are planning Pages of Math, a new online resource to help students and researchers who want to perform in-depth investigations on topics in the K-12 curriculum.

Other new projects take a close look at online professional development. For example, the Math Forum is involved in ESCOT http://www.escot.org, a collaborative effort with SRI, SimCalc, Geometer's Sketchpad, The ShowMe Center, and others to investigate the effectiveness of building integrated teams composed of teachers, curriculum disseminators, Web developers, and software programmers to develop classroom technologies.

The Math Forum is also partnering with TERC, a nonprofit education research organization in Cambridge, Massachusetts, on Bridging Research and Practice, another project to research the use of multimedia articles for professional development. The partners will explore the ways in which communities can make use of online writing and discussion grounded by classroom video. The Math Forum is also seeking funding to work with school districts in developing online professional development resources tailored to their local standards and curriculum priorities.

The Math Forum is a favorite of teachers who visit ENC Demonstration Sites to improve their Internet skills. Novices often comment on how easy it is to navigate the site. It is an exciting example of how a Web resource can spark interest, discussion, and new projects by bringing together a virtual community focused on improving education. ●

Funded by the National Science Foundation, the Math Forum is located at Swarthmore College, Swarthmore, Pennsylvania. Visit the Web site at: http://forum.swarthmore.edu/

ENC Online Features the Math Forum's Teacher-Created Materials

Teachers can share math lessons in The Math Forum's Web Units and Lessons section. Some of these units have won ENC Online Digital Dozen awards. Here are two of our favorite teacher-created materials:

http://forum.swarthmore.edu/sum95/suzanne/tess.intro.html

Tessellation Tutorials was first featured on ENC Online in May, 1996. This unit contains a series of tutorials that show students how to tessellate. The series offers a number of useful teacher resources including an introduction called What Is a Tessellation? and a section called Where's the Math? that elaborates on underlying geometric principles. Historical information and samples of student work are also included.

http://forum.swarthmore.edu/alejandre/

Suzanne's Math Lessons won the Digital Dozen award in June, 1998. Math Forum Teacher Associate Suzanne Alejandre has created a collection of Web units with activities and procedures for teaching on a range of topics including geometric factoring, circle designs, and fractals. Some units include software links, connections to national standards, and cross-disciplinary ideas.

Find out about these and other Digital Dozen winners by visiting ENC Online at http://www.enc.org

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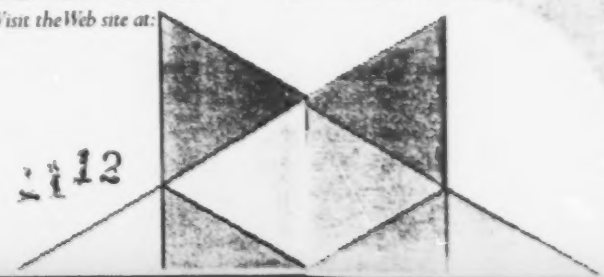


ENC Partners: Eisenhower Consortia & ENC Demo Sites

Appalachian Region
Kentucky, Tennessee, Virginia, West Virginia

consortium

Eisenhower Regional Math/Science Consortium at AEL
Pam Buckley, Director
1700 North Moore Street, Suite 1275
Arlington, VA 22209
Toll-free: (800) 624-9120
Fax: (703) 276-0266
E-mail: buckleyp@ael.org
aelinfo@ael.org
URL: http://www.ael.org/eiser/

demo site

George Watson
Marshall University
Room 101 Jenkins Hall
Huntington, WV 25755
Phone: (304) 696-2874
Fax: (304) 696-6221
E-mail: watson@marshall.edu

Mid-continent Region
Colorado, Kansas, Missouri, Nebraska, North Dakota, South Dakota, Wyoming

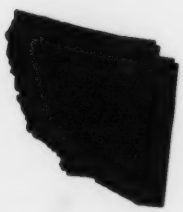
consortium

Eisenhower High Plains Consortium for Mathematics and Science
John Sutton, Director
Mid-continent Regional Educational Laboratory
2550 South Parker Road, Suite 500
Aurora, CO 80014
Toll-free: (800) 949-6387
Fax: (303) 337-3005
E-mail: jsutton@mcrel.org
URL: http://www.mcrel.org/hpc/

demo site

Eisenhower High Plains Consortium for Mathematics and Science
2550 South Parker Road, Suite 500
Aurora, CO 80014
Phone: (303) 337-0990
Fax: (303) 337-3005
Toll-free: (800) 949-6387

Far West Region
Arizona, California, Nevada, Utah



consortium

WestEd Eisenhower Regional Consortium for Science and Mathematics Education
Art Sussman, Co-Director
Steve Schneider, Co-Director
730 Harrison Street
San Francisco, CA 94107-1242
Phone: (415) 241-2730
Fax: (415) 241-2746
E-mail: asussma@wested.org
program: werc@wested.org
URL: http://www.wested.org/werc/

demo site

Anne Malley
Biodiversity Resource Center
California Academy of Sciences
Golden Gate Park
San Francisco, CA 94118
Phone: (415) 750-7361
Fax: (415) 750-7106
E-mail: amalley@cas.calacademy.org

North Central Region
Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, Wisconsin

consortium

Midwest Consortium for Mathematics and Science Education
Gil Valdez, Director
North Central Regional Educational Laboratory
1900 Spring Road, Suite 300
Oak Brook, IL 60521-1480
Phone: (630) 571-4700
Fax: (630) 571-4716
E-mail: valdez@ncrel.org
URL: http://www.ncrel.org/msc/msc.htm

demo site

Susan Dahl
Fermi National Accelerator Laborato
Lederman Science Education Center
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Batavia, IL 60510-0500
Phone: (630) 840-3094
Fax: (630) 840-2500
E-mail: sdahl@fnal.gov

Mid-Atlantic Region
Delaware, District of Columbia, Maryland, New Jersey, Pennsylvania

consortium

Mid-Atlantic Eisenhower Consortium for Mathematics and Science Education
Keith M. Kershner, Director
Research for Better Schools
444 North Third Street
Philadelphia, PA 19123-4107
Phone: (215) 574-9300 ext. 279
Fax: (215) 574-0133
E-mail: kershner@rbs.org
mathsci@rbs.org
URL: http://www.rbs.org

demo site

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E-mail: donahoe@rbs.org

Northeast and Islands Region
Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, Vermont, Puerto Rico, Virgin Islands

consortium

Eisenhower Regional Alliance for Mathematics and Science Education Reform
Mark Kaufman, Director
TERC
2067 Massachusetts Avenue
Cambridge, MA 02140
Phone: (617) 547-0430
Fax: (617) 349-3535
E-mail: mark_kaufman@terc.edu
URL: http://ra.terc.edu/alliance/hubhome.html

demo site

Molly Singsen
Regional Alliance/TERC
2067 Massachusetts Avenue
Cambridge, MA 02140
Phone: (617) 873-9725
Fax: (617) 349-3535
E-mail: molly_singsen@terc.edu

Contact the Eisenhower Consortium or ENC Demonstration Site that serves your state for assistance in improving mathematics and science education.

Northwest Region
Alaska, Idaho, Montana, Oregon, Washington

consortium

Science and Mathematics Consortium for Northwest Schools
Ralph T. Nelsen, Director
Columbia Education Center
171 NE 102nd Street
Portland, OR 97220-4169
Phone: (503) 760-2346
Fax: (503) 760-5592
E-mail: ralph@col-ed.org
URL: http://www.col-ed.org/smcnws/

demo site

Kristen McCowan
Information Science Hall
Oregon Museum of Science and Industry
1945 SE Water Avenue
Portland, OR 97214-3354
Phone: (503) 797-4585
Fax: (503) 797-4568
E-mail: kam@omsi.edu

Southeast Region
Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina

consortium

Eisenhower Consortium for Mathematics and Science Education at SERVE
Francena Cummings, Director
1203 Governors Square Boulevard, Suite 400
Tallahassee, FL 32301
Phone: (850) 671-6033
Fax: (850) 671-6010
E-mail: fdc3530@garnet.acns.fsu.edu
URL: http://www.serve.org/Eisenhower/

demo site

Ed Anderson, Regional Coordinator
Metro Atlanta Georgia Youth Science & Technology Center (GYTSC)
PO Box 54244
Atlanta, GA 30308
Phone: (404) 589-8008
Fax: (404) 589-0032
E-mail: edanderson@mindspring.com

Pacific Region
American Samoa, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Guam, Hawaii, Republic of the Marshall Islands, Republic of Palau

consortium

Pacific Mathematics and Science Regional Consortium
Paul Dumas, Director
Pacific Resources for Education and Learning
1099 Alakea Street, Suite 2500
Honolulu, HI 96813
Phone: (808) 441-1300
Fax: (808) 441-1385
E-mail: dumasp@prel.hawaii.edu
askmathsci@prel.hawaii.edu
URL: http://w3.prel.hawaii.edu/programs/ms/math-science.html

demo site

Alice Borja
Pacific Mathematics and Science Regional Consortium
PREL Guam Service Center
PO Box 326359
Hagatna, GU 96932-6359
Phone: (808) 533-6000 ext. 133
Fax: (808) 533-7599
E-mail: borjaa@prel.hawaii.edu

Southwest Region
Arkansas, Louisiana, New Mexico, Oklahoma, Texas

consortium

Eisenhower Southwest Consortium for the Improvement of Mathematics and Science Teaching
Steve Marble, Director
Southwest Educational Development Laboratory
211 East Seventh Street
Austin, TX 78701
Phone: (512) 476-6861
Fax: (512) 476-2286
E-mail: scimast@sedl.org
URL: http://www.sedl.org/pitl/scimast/welcome.html

demo site

Southwest Consortium for the Improvement of Mathematics and Science Teaching (SCIMAST/SEDL)
211 East Seventh Street
Austin, TX 78701-3281
Phone: (512) 476-6861
Fax: (512) 476-2286

Eisenhower National Clearinghouse for Mathematics and Science Education
Columbus, Ohio

demo site

Gail Hoskins
Eisenhower National Clearinghouse
The Ohio State University
1929 Kenny Road
Columbus, OH 43210-1079
Toll-Free: (800) 621-5785
Phone: (614) 292-7708
Fax: (614) 292-2066
E-mail: ghoskins@enc.org
URL: http://www.enc.org/

enc
Eisenhower National Clearinghouse for Mathematics and Science Education

ENC Capital Collection & Demonstration Site
Washington, D.C.

demo site

Shirley DeLaney
The George Washington University
Instructional Media & Materials Center
Gelman Library, Room 806
2130 H Street, NW
Washington, DC 20052
Phone: (202) 994-7048
Fax: (202) 994-4520
E-mail: enc@gwis2.circ.gwu.edu

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AMERICA COUNTS

An Initiative to Help Students Achieve in Mathematics

Building on the success of America Reads, government agencies partner to improve mathematics education.

by Wendy Goldstein, U.S. Department of Education

Today's students must master advanced skills in mathematics, science, and technology to be prepared for college and promising careers. Recognizing this, U.S. Secretary of Education Richard W. Riley has made improving student achievement in mathematics one of his priorities. The Department of Education—in partnership with the National Science Foundation—has initiated America Counts, a multifaceted program that is guided by six strategies:

- Equip teachers to teach challenging mathematics through high-quality preparation and ongoing opportunities for professional growth.
- Provide personal attention and additional learning time for students who could benefit from it.
- Support high-quality research to inform best practices of mathematics teaching and learning.
- Build widespread public understanding of the mathematics today's students must master.
- Encourage a challenging and engaging curriculum for all students based on rigorous standards that meet national and international benchmarks of excellence.
- Promote the coordinated and effective use of federal, state, and local resources in support of higher student achievement in mathematics.

For each strategy, there are a number of projects underway; resource materials are available to help students, parents, schools, and communities improve mathematical learning. Two of the newest projects include the creation of a National Commission on Mathematics and Science Teaching and Learning for the 21st Century and the *America Counts* Federal Work-Study Program.

National Commission on Mathematics and Science Teaching and Learning for the 21st Century

Chaired by former Senator John Glenn, this high-profile commission will focus attention on the challenges and opportunities of teacher recruitment, preparation, retention, and professional growth for mathematics and science teachers.

Increasing the number of highly qualified teachers across the nation and providing opportunities for teachers to upgrade their skills are critical to improving student achievement in math and science. Unfortunately, many mathematics and science teachers today lack the appropriate credentials and licensure for the subjects they teach, and a significant number of those who are appropriately certified are underprepared in their disciplines. Future teacher shortages—especially in mathematics and science—and student population growth are likely to exacerbate these problems.

The Glenn Commission will meet several times over the next year to review issues relevant to teacher quality in mathematics and science education. In the fall of 2000, it will produce a report focused on specific action steps that federal, state, and local policymakers can take to strengthen the classroom practice of mathematics and science teachers.

Joining Senator Glenn on the Commission will be representatives from several of the following constituencies: federal, state, and local officials; university presidents; business leaders; superintendents; school board members; principals; chief state school officers; distinguished leaders in mathematics and science; classroom teachers; and public representatives. Ex-officio, non-voting members will include representatives from several federal agencies.

America Counts Federal Work-Study (FWS) Program

Building on the success of America Reads, Secretary Riley has expanded the FWS Waiver Program to include mathematics tutoring for elementary through ninth grade school children. Effective July 1, 1999, this waiver allows the federal government to pay 100 percent (as opposed to the usual cost-sharing that is required of higher education institutions) of an eligible FWS student's wages if he or she works as a math tutor for any public or private non-profit entity, including local schools and community-based organizations.

To help support the creation of high-quality tutoring programs, the Department of Education and the National Science Foundation are currently developing new—and identifying existing—resource materials that can be used for America Counts tutoring programs. As these resources become available, they will be posted on the America Counts Web site. Schools or community-based organizations that have a need for mathematics tutors should contact the financial aid or community service offices of any nearby higher education institutions. Individuals interested in volunteering their expertise and time in helping train tutors should also contact these offices. ●

For more information about these and many other America Counts efforts, please visit the Web site: http://www.ed.gov/inits/Math/
Or call: (877) 220-9684.

AMERICA COUNTS *Challenge*

Using the Internet in the Classroom

Getting What You Want from the Web

In each issue, ENC's Associate Director of Instructional Resources gives advice to teachers about how to use the World Wide Web. Much of her knowledge comes from her experiences introducing students to the Internet.

by Kimberly S. Roempler, ENC Instructional Resources

Every month, staff members at ENC search the Web to find the very best mathematics and science Web sites for our Digital Dozen, a monthly listing of 13 highly recommended sites on the Web. I start my searches for Digital Dozen candidates on my favorite search engines and Web sites. But an hour later, I might find myself tempted to read about the latest cookbooks on Amazon.com or order chocolates from the Godiva Chocolate Web site. Does this sound familiar?

Surfing the Net is like perusing the bookshelves in a bookstore with nothing particular in mind—going from one section to the next simply because a bright-colored book jacket catches your eye. I have spent many happy afternoons wandering through my favorite bookstore in this manner.

Searching, on the other hand, is targeted. I know what I want. I go to the Information Desk or to a specific section in the bookstore. I have the title of the book and the author's name—or at least a topic in which I am interested. I find the book and get out.

The World Wide Web is the biggest bookstore any of us has ever encountered. Where is the Information Desk? How is the "store" organized? How can I get what I want from the Web?

Understanding how the Internet is indexed is a beginning. In my column in the last issue of *Focus*, I explained that there are three main types of search engines: indexes, directories, and those that are multi-threaded. I also made some recommendations. The index I use regularly is AltaVista http://altavista.com My preferred multi-threaded search engines are Ask Jeeves http://www.askjeeves.com and MetaCrawler http://www.go2net.com/channels/education/ because both simultaneously search multiple directories and indexes and compile the results. Yahoo! http://yahoo.com/ is my favorite directory. Directories allow you to browse information based on categories developed by the service provider.

However, just in the time since I wrote my last column, these distinctions are becoming blurred. For example, Alta Vista now includes a list of categories (like Yahoo!) and provides an "Ask A Question" service like Ask Jeeves. Search engines are expanding and now call themselves Web portals or hubs—places where people come to the Web to get information about a multitude of subjects, to chat, to send e-mail, and to form online communities.

Working Through an Example—Hands-On!

The best way to understand, of course, is to work through an example hands-on. So turn on your computer, get online, and put yourself in the place of an elementary teacher who has just received the word that your school district has decided to emphasize the use of technology in the classroom. You decide that you need more information about what other elementary schools are doing with educational technology. You choose an indexed search engine because you have a specific topic in mind. So, go ahead, open up AltaVista http://altavista.com/ and work through the examples starting on the next page.

Using Other Tools

MetaCrawler

http://www.go2net.com/channels/education/ is a multi-threaded search engine, offering a wide variety of ways to access information. The advanced search strategies are very similar to that of AltaVista.

Metacrawler also allows you to customize your searches. It has a series of Channels that can be the first way of narrowing down your search field. The Channels include Education, Computing, Entertainment, and Finance. An online discussion is associated with each Channel. Other sections on the home page include Today's News, Stock Prices, PlaySite (play games online), MetaSpy (a service that keeps track of what words people are searching on), and a list of Useless Pages.

Ask Jeeves search engine

http://www.aj.com/ can almost be compared to the person at an Information Desk. This search engine is set up so that the user can ask questions such as "What is a tornado?" or "Where can I find geology lesson plans?" The results are different than that of AltaVista. The question the searcher asks produces one to ten more questions. The searcher then clicks on the question that will hopefully provide the wanted information. Ask Jeeves also uses other directories and indexes like a multi-threaded search engine to provide even more information. However, the return list from the searches on Yahoo! and Metacrawler, for example, are very small—perhaps 10 to 20 pages of information are returned, an amount that is much more useful than the volumes returned on a regular search.

For a hands-on example, access the site and type Where can I find information about Yellowstone National Park? in the search box. Returned is a list of questions from which you choose the most appropriate. A set of links from Yahoo!, AltaVista, and Lycos is also returned.

This search engine is not without its quirks. I asked the question "Where can I find information about searching the Web?" The questions that were returned included "Where are coral reefs located?" and "How are fossils found?" I was much more successful using AltaVista and MetaCrawler in this situation.

Roempler's Recommended Resources:

How to Search the World Wide Web:
A Tutorial for Beginners and Non-Experts
http://www.ultranet.com/~egrlib/tutor.htm

Tutorial: Guide to Effective Searching of the Internet
http://thewebtools.com/searchgoodies/tutorial.htm

Searching the Internet: Recommended Sites and Search Techniques
http://www.albany.edu/library/internet/search.html

Spider's Apprentice
http://www.monash.com/spidap.html

Type the following words in the search box: educational technology. Hit the Search button and peruse the results. (When I did this search, more than 70,000 pages were returned.)

Now type the following question in the Search box: Where can I find information about educational technology? Hit the Search button. (In my search, almost 740,000 pages of information were retrieved.)

Obviously, both of these attempts resulted in an overwhelming amount of information—and who knows if it is all relevant? How do we hone in on what we really want to know?

Narrowing Your Search

One way to narrow your search is to use the Language pull-down menu in the AltaVista search box. This feature allows you to exclude Web sites written in languages other than English.

Narrowing your search by making your search terms more specific also limits the number of returned pages. You can also use quotation marks around a phrase or a plus (+) or minus (-) in front of your search terms to achieve more precise results.

So let's go back to your computer. Type "educational technology" +"professional development" in the Search box using the quote marks. Also choose English from the Language pull-down menu. Hit the Search button (29,000 pages were returned when I did this).

Let's narrow the search even more by typing in +K-6 after "educational technology" + "professional development" in the Search box. Use your browser's back button to get to the original search. (In my search, this finally gave me a reasonable number of pages returned—1,400.)

Refining Your Results

Another feature offered by Alta Vista is the Refine service. This allows you to include or exclude specific words provided by Alta Vista based on the returned pages of information. The Refine tool dynamically sorts your results into different topics to help you become more exact with your search keywords. It works like a dynamic thesaurus by giving you suggested good keywords to make your search more precise.

Back on the computer, start with the "educational technology" +"professional development" +K-6 search. Now, click on the Refine Your Search hot link. You'll see the Refine List View, which lists topics in order of their likely relevance to your search. If you select Require, the associated topic will always be included in your results. If you select Exclude, you will never see the associated topic in your results.

Using the drop-down menus, choose Require Teachers and Exclude Districts. Pressing the Refine Again button generates a new Refine list, based on the Require or Exclude settings you selected. You can continue to refine the search as many times as you want. It is better to select Require or Exclude for only a few topics before you redo your search each time. Just remember that, over time, more and more documents will be indexed, so the number of documents returned as well as the Require and Exclude terms will change.

Through the Refine process, you have finally gotten to a list that is not only manageable but makes sense. By clicking on the hot links, you can find information that an elementary teacher might want to know about what types of professional development opportunities other districts are providing their teachers, a link to an ENC publication *ENC Focus:* Calculator Active Materials, a copy of a technology assessment survey, and an online community where you can ask questions of other educators who have had the same experiences as you.

Learning to search the Internet can be a very time-consuming process, especially when you are a novice. Once you are comfortable with at least two of the many available search engines, be sure to bookmark them so they will be right at your fingertips. And remember, no single search engine will give you everything you want.

Also, be sure to help your students learn how to search the Internet, too. They need the ability just as much as you. Once they are proficient, you can give students your "wish list" and have them retrieve information. Asking them to explain their search strategies increases the value of the assignment. This is a very high-interest activity for students and saves you time. ●

Spider's Apprentice Rankings

Visit Spider's Apprentice for the latest results of that site's rating system for Web search tools. *(Runners Up are in parentheses.)*

Biggest, Fastest, Coolest:	HotBot *(AltaVista)*
Most Comprehensive Results:	Excite *(Lycos)*
Highest Overall Usability Rating:	Infoseek *(Yahoo!)*
Most Relevant Results:	Infoseek *(HotBot)*
Most Likely to Find a Hit When Others Can't:	Northern Light *(Infoseek)*

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Going for Grants

Corporate Foundations

In the last issue of *ENC Focus: A Magazine for Classroom Innovators*, this column presented information about federal grants available to educators.

by Tracy Crow, ENC Publishing

Continue your grant-seeking journey with ENC as we enter the complex arena of foundations. There are many types of foundations—community, private, operating, and corporate, to name the big ones. The differences are based on a number of factors: Internal Revenue Service regulations, where the foundation money came from, and what the foundation money will be used for. Comprehending the differences can be confusing, but one type of foundation that is relatively easy to understand is the corporate foundation.

First of all, what is a foundation? It is an organization established to provide funding or support to particular activities. Corporate foundations are created by existing for-profit companies and usually act as independent organizations. The corporations may establish these foundations through ongoing contributions or sizable endowments.

Generally, a corporate foundation will support those activities that complement the goals of the profit-making company with which it is associated. That makes math and science education great fields for those seeking grants in the corporate world. The number of corporations dependent on a math- and science-literate public is very high. After all, those companies will need well-prepared employees and well-informed consumers. Not to mention that the people who serve in these corporate environments have succeeded as a result of their own backgrounds in mathematics and science!

Companies That Give

Almost any big company you can name has some kind of granting or funding program. Most technology companies have their own foundations or education grant programs—think computer hardware (Apple, IBM, Hewlett-Packard), components (Intel), software (Microsoft, Adobe), network computing (Sun, Cisco Systems), wiring and telecommunications (MCI Worldcom, Bell Atlantic). And that's just part of the technology world! Many companies, especially those that create and sell hardware, have equipment-granting programs. So don't just think about dollars and cents—donated hardware and software may take you a long way in implementing your improvement efforts.

Both science and mathematics education benefit from science-oriented companies, from pharmaceuticals and medical research (Genentech, Pfizer) to energy and natural resources (Exxon, BP) to chemicals (Dow, Monsanto). The list of companies that fund programs for education is almost limitless—car manufacturers, department stores, banks, insurance companies, publishers. You will have to do some searching to see exactly what programs these companies are willing to support, but chances are you will find a match for the math, science, technology, or professional development project you want to get started.

If you know of a company you would like to explore on your own, visit the corporate Web page and look for their giving programs. Usually that information is under corporate information, in a community or outreach area, or in an education portion of the site. But you don't have to know what company to go to—there are sources that can help you in your search for an appropriate program.

Location, Location, Location

Here's one example of a corporate foundation keeping its money close to home. The Medtronic Foundation awards its grants to schools, districts, and nonprofit organizations in or near these Medtronic facilities: Tempe, Arizona; Anaheim, Santa Barbara, Santa Ana, and San Diego, California; Parker, Colorado; Danvers, Massachusetts; Grand Rapids, Michigan; Milaca and Minneapolis/St. Paul, Minnesota; and Humacao and Villalba, Puerto Rico.

Medtronic's science education program, STAR, strives to create initiatives that increase science learning by K-12 students, particularly those traditionally underrepresented in science, such as females and disadvantaged youth. STAR grants are awarded to programs that include these five aspects of successful science programs:

- The curriculum includes hands-on strategies, real life examples, multicultural materials, and developmentally appropriate concepts.
- Teachers are encouraged to use a variety of materials that increase their science knowledge and interest.
- All educators hold high expectations that all students, regardless of background, can succeed in science.
- Students have opportunities, such as clubs or other group experiences, to provide one another with support in their interest in science.
- Assessment is geared to program objectives and used to modify program development.

See http://www.medtronic.com/foundation/star.html for more information.

And the Winner Is...

Teacher competitions and awards designed to honor excellence in teaching are another source of funds. These grants can be used in a variety of ways—to buy materials or pay for professional development opportunities such as attending national or regional conferences or taking courses or workshops. In some cases, teachers are not permitted to nominate themselves for the award.

A Teacher's Guide to Fellowships and Awards
http://www.doe.mass.edu/doedocs/tgfatoc.html
This Web site is an excellent source of information for locating these types of funds; helpful advice about applying is provided. Some programs listed there include:

CIBA Specialty Chemicals Exemplary Middle Level and High School Science Teaching Award
Sponsored by CIBA Specialty Chemicals.
This program recognizes one middle level and one high school teacher who have demonstrated excellence in one of several areas, including designing innovative teaching, creatively using teaching materials, and developing programs that stimulate interest in science. These teachers are awarded $1,000, a one-year membership in the National Science Teachers Association (NSTA), and up to $500 to attend the NSTA National Convention.
Application Information:
NSTA Awards Programs, 1840 Wilson Boulevard, Arlington, VA 22201-3000, (703) 243-7177.
Application deadline is November 15.

Radio Shack/Tandy Scholars Program
Sponsored by the Tandy Corporation, administered by Texas Christian University.
This program awards $2,500 to one hundred teachers who have demonstrated excellence in math, science, and computer science.
Application Information:
Kaye Thornton, Program Coordinator, Tandy Technology Scholars, TCU, PO Box 32897, Fort Worth, TX 76219, (817) 924-4087, fax (817) 927-1942.
Application deadline is in mid-October.

Locating Corporate Grants

Public libraries have volumes of information to help, along with reference assistance. If you have access to the World Wide Web, you can do a lot of your research online. The first and best place to start your search online is the Foundation Center http://fdncenter.org/. Established in 1956, the Foundation Center is an independent nonprofit clearinghouse for information about foundations, corporate giving, and related subjects.

The Foundation Center's Web page lists hundreds of foundations of all types, with application procedures and links to foundation Web sites. A simple search engine makes narrowing down the choices fairly simple—you will be amazed at the number of programs offering money or equipment for math and science education.

The general public can also visit Foundation Center libraries in New York, Washington, DC, Cleveland, Atlanta, and San Francisco for assistance in using their publications and other philanthropy-related materials. The Center offers workshops on proposal writing for a cost and free orientations to their materials at the Center libraries. In addition to the physical locations and the Web site, the Foundation Center also publishes directories and the *Guide to Proposal Writing*. Their database of foundation information is also available on CD-ROM.

The Foundation Center
79 Fifth Avenue/16th Street
New York, NY 10003-3076
(212) 620-4230 or (800) 424-9836
Fax: (212) 807-3677

Specific Requirements

Each corporate foundation funds specific programs meeting well-defined criteria. For example, many corporations establish programs for the communities where they are located (see Location, Location, Location sidebar on page 13). The criteria will most likely specify who can receive the grants—either individuals or districts or perhaps collaborations between universities and schools.

Before you decide to pursue a particular grant, read through all of the application information to determine if you and your project are eligible. In some cases, individuals might turn to corporate-sponsored contests or awards (see And the Winner Is... sidebar).

Sample Programs

So what kinds of programs do corporate foundations fund? Just a few examples are listed below. See the corporate Web pages for more information about these and other programs.

Hewlett Packard
http://webcenter.hp.com/grants/
HP's U.S. National Grants program focuses on K-12 education, particularly math and science education. HP works to give all students, including women and minorities, opportunities to succeed in school. Their funded programs emphasize professional enhancement and curriculum development. In one recently funded program, the California Institute of Technology in Pasadena received $72,000 worth of HP equipment to create seven computer-equipped labs in the Pasadena Unified School District middle and high schools. The new computer labs will be used in teaching inquiry-based science content modules.

Exxon
http://www.exxon.com/exxoncorp/
Exxon's Education Foundation funds both mathematics and science initiatives. During the past decade, the K-3 Mathematics Specialist Program has awarded 272 grants to ninety school districts. Projects emphasize the professional development of teachers. This foundation also awards grants to NCTM to provide a network of support for project teachers.

Pfizer
http://www.pfizer.com/pfizerinc/philanthropy/home.html
Pfizer emphasizes mathematics and science in its education programs. One project, Hands-On/Minds-On: Science & Math Training and Curricula, was created to improve inquiry-based math and science education through professional development and curriculum use and development. Other programs fund informal science institutions and the integration of technology in science and mathematics. ●

References
Try these additional Web sites to learn more about corporate grants and competitions.

Grants and Other (People's) Money
http://quest.arc.nasa.gov/top/grants.html
Funded by NASA, this site points out specific grants and when they are available, with links to general resources as well.

Council on Foundations
http://www.cof.org/
This is the association for foundations and corporations that give grants. This Web site gives a good overview of what a foundation is and the difference between different types of foundations.

The National Science Teachers Association
http://www.nsta.org/
NSTA's Web site has a section devoted to teacher and student awards and competitions, many of them co-sponsored by corporations.

Link to all the Web sites mentioned in this article via ENC Online:
http://www.enc.org/focus/

ENC Online Is the One-Stop Web Site for Teacher Research

This teacher put ENC Online at the top of his list of resources for colleagues researching a new mathematics curriculum. Join them by visiting http://www.enc.org/

by Blake West, Coordinating Teacher for Technology Integration

This year, I became a District Coordinating Teacher for technology. (Up until now I have been a teacher of computer science and math at Blue Valley North High School in Overland Park, Kansas.) I am a resource person on all curriculum committees, and I work to help teachers plan and deliver lessons and implement projects using technology.

Our school district is in the research phase of rewriting our math curriculum, and last year I put together an intranet for our teachers to investigate worthwhile research information. This internal Web site includes many links to the World Wide Web, and ENC Online http://www.enc.org/ is at the top of the list.

ENC has links to valuable resources about the TIMSS reports and links to national standards—as well as standards from other countries. It also has links to many of the states' math standards. This truly is the one-stop Web site for anyone interested in using technology effectively and improving instructional practice.

My personal favorite is the Digital Dozen. [Editor's Note: Digital Dozen is a selection of 13 exemplary mathematics and science education sites chosen monthly by ENC staff.] This feature, along with NCTM's *The Mathematics Teacher*, are two resources I use on a monthly basis to maintain my personal focus on instructional improvement. Using one idea a month from each of these sources is a worthy goal to keep the creativity and enthusiasm flowing for the teaching and learning process!

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Editor's Note:
To peruse selected articles from *The Mathematics Teacher*, NCTM's monthly publication for secondary mathematics teachers, visit http://www.nctm.org/mt/mt.htm. Subscription information for this publication and NCTM's other journals is available at http://www.nctm.org/member.service/

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Focus On: Inquiry in the Everyday World of Schools

A member of ENC's Science Advisory Board takes a closer look at the meaning of inquiry.

by Ronald D. Anderson, University of Colorado

Inquiry is a word with a long-standing place of honor in science education circles. It was the label for many of the new approaches to teaching promoted in the NSF-funded curriculum materials of the 1950s and 60s. It has a central place in the current National Science Education Standards (NSES). It is the favored word for describing the essence of good science teaching; seemingly, everyone uses it and there seems to be little disagreement about it.

But is everyone talking about the same thing when they use the word inquiry? If we got precise about its meaning, would we still be agreeing with each other? What does it look like in the classroom? What are the results?

A close look at the NSES shows inquiry is used in at least three different senses:

- scientific inquiry,
- inquiry learning, and
- inquiry teaching.

Scientific inquiry refers to the means scientists use to study nature and formulate explanations of what they observe. It deals with how science proceeds and can be considered independently of educational processes.

Inquiry learning refers to the active processes in which students are engaged as they pursue increased understanding of science. The writers of the NSES obviously see some relationship between scientific inquiry and inquiry learning. It is thought that student learning in a school context should reflect the nature of inquiry in the world of science. While the word "constructivism" is not used in the NSES—possibly because its meaning varies significantly among its users—inquiry sometimes appears to be used in the NSES in a similar way. In fact, many scholars who study human learning would argue that significant learning demands an active process for which the label of constructivism, or inquiry learning, would be appropriate. In other words, inquiry is the essence of learning.

Inquiry teaching as used in the NSES has no precise operational definition, although, however it is understood, it seems to be something that promotes inquiry learning. This lack of clarity as to what inquiry teaching entails is at the heart of many teachers' struggles to put the NSES into practice. This same lack of clarity is found in the extensive body of research studies on inquiry teaching; it is defined differently by different researchers, and often in terms that are not easy to use in talking about the everyday activities of a teacher in the classroom.

In the interest of being able to communicate in concrete terms, the rubric in the box to the right may be of help. It was developed in connection with case studies of schools from across the country that were judged to be successful in putting into practice reforms such as those advocated in the NSES and the 1989 NCTM standards for mathematics (Anderson, 1996).

Understanding what is entailed in inquiry teaching, and inquiry learning, requires close attention to three tangible aspects of the classroom—the role of teacher, the role of students, and the nature of student work—described in the rubric. The specifics listed in the rubric were observed in actual classrooms and are offered here as a beginning point for personal reflection on our own teaching.

Research has some important insights to offer as assistance in this personal reflection. Review of a large number of research studies supports the following generalizations:

1. When inquiry teaching actually is put into practice, it works; i.e., student learning is enhanced.
2. It is possible to put inquiry teaching into practice, but it is a demanding task, and it is not clear how widespread one can expect it to become.
3. The barriers and dilemmas experienced in putting inquiry teaching into practice are closely related to teachers' basic values and beliefs about teaching and learning.
4. Teachers need and deserve a great deal of assistance in putting inquiry teaching into practice (Anderson, 1998).

Sources of information are available about how to put new forms of teaching and learning into practice (e.g., Anderson & Pratt, 1995). In addition, it is hoped that the work of such groups as the Center for Science, Mathematics and Engineering Education at the National Research Council will soon provide significant additional help in putting inquiry teaching and inquiry learning into practice in schools. It is the right direction to go, but getting there will be a big challenge. ●

Ronald D. Anderson is a researcher and teacher educator at the University of Colorado, Boulder. Among his many professional activities, he serves as a member of the ENC Science Advisory Board.

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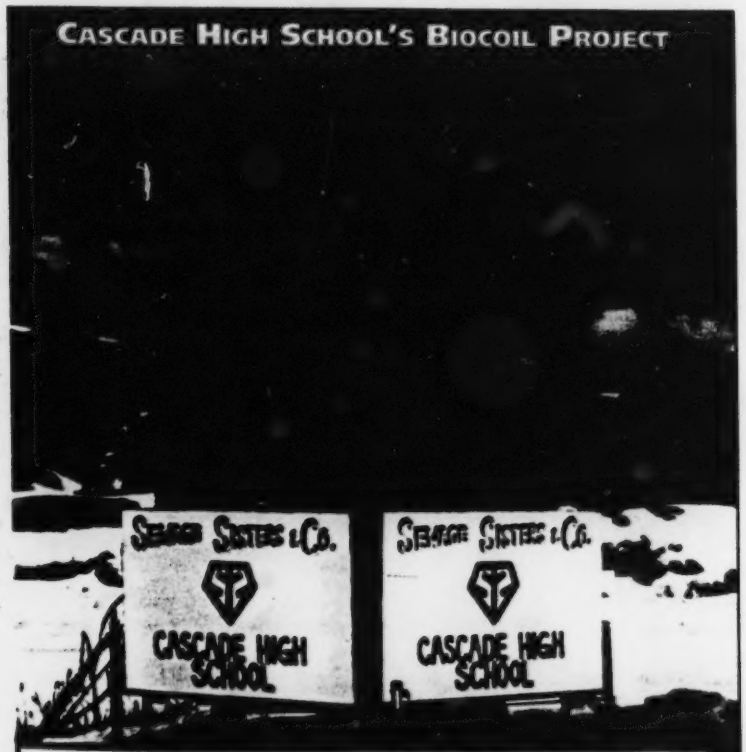
Traditional—Reform Pedagogy Continuum

In the Cascade Reservoir Restoration Project

Students Tackle Real-World Problems

The population sign at the corporation limit of Cascade, Idaho, jokingly boasts that the town has 1,001 residents; the high school has 135 students. The small size of the town and school does not stop this science teacher from engaging his students in an ongoing project that has captured attention from around the world. In this issue, teacher and students write about the Cascade Reservoir Restoration Project from their different perspectives. In the next issue, which focuses on Educational Technology, Cascade High School students write about their student-developed Web sites. To get a preview, visit http://www.cascadehs.csd.k12.id.us/advbio/home.html



Sewage and Other Realities of Life

One of the most widely known projects to emerge from Clinton Kennedy's advanced biology class at Cascade High School involves the construction and testing of a Biocoil, a water purification device developed by a British firm, Biotechna. For a detailed description of the project, visit that portion of the school's student Web site:

Briefly, Biotechna claimed that the Biocoil could remove 92% of the nitrates and 98% of the phosphates from wastewater. After researching the device, a group of Kennedy's students proposed that the city of McCall, Idaho, test the Biocoil as a possible solution to the water quality problems in Cascade Reservoir.

Because of the expense, McCall declined the suggestion, but the students were not to be deterred. Adopting the identity of the Sewage Sisters, the group built and tested their own, award-winning Biocoil. However, the magnitude of the project extended far beyond the time that any one student is enrolled in a high school course, even a two-year course.

In this article, four of Kennedy's students, two former and two current, reflect on their experiences with the Biocoil and what doing real science means to them.

Continued on next page.

By Clint Kennedy, Biology Teacher, Cascade, Idaho, High School

"Swimmers beware! Contact with water may be hazardous to your health."

These were the headlines that greeted Cascade Reservoir users during the summer of 1993. The news items continued:

"The smell may cause nausea and/or severe headaches, and the green slime is unpleasant to touch and may cause a red, irritating rash. Swimming may bring contact with decomposing animal carcasses. Note: 22 cattle recently perished from ingesting this water. Proceed at your own risk."

What had happened to the clear, cold, sparkling water for which Idaho is famous?

That was the compelling question that galvanized my students and led me to a whole new way of teaching the advanced biology class at Cascade High School. The Cascade Reservoir Restoration Project, as the course curriculum is called, deals with real-life problems that directly connect with students. It has allowed me to reach an important goal: my students do not simply learn about science; they actually do science.

Understanding the Problem

Cascade High School's advanced biology course has evolved into a two-year program. Students join the class as juniors and work on their specific projects through their senior year. Class periods are 95 minutes long, allowing complex labs to be run during class time. Field trips are taken for half days, full days, and weekends.

Entering students must learn enough science to understand that the reservoir is experiencing the effects of ultra-eutrophication: the increase of dissolved nutrients such as phosphate resulting in algae blooms that deplete the amount of oxygen in the water. The project begins by introducing the facts of limnology, the study of bodies of fresh water. This information is presented through lectures and visits to the lake for hands-on labs and demonstrations. Formal field trips with staff from agencies such as the Bureau of Reclamation and the Department of Environmental Quality allow students to see how professionals use limnology to manage the lake and its watershed.

This introduction emphasizes how the physical, chemical, and biological components of a water body integrate with each other. Students learn to consider the physical profiles of

Cascade Reservoir including altitude, geology, watershed characteristics, water flow, and land management practices. Students examine maps and aerial photos, take field trips to various locations, and discuss these characteristics to understand how they make the reservoir unique.

Students then study the chemical composition of the water in Cascade Reservoir. They run chemical water tests using instruments, starting with Hach and Lamotte test kits and proceeding to colorimeters, pH meters, conductivity meters, and spectrophotometers and Beer's Law analysis of ions. Students learn advanced chemistry as they make their own standards using electronic balances and serial dilutions, graph data, and employ computer interfacing to laboratory equipment.

The class uses the water quality index provided by the SITE (Students Investigating Today's Environment) program, which shares discoveries and measurements on a computer network with students conducting similar experiments across the state. Students collect data at many locations and at several different times of the year.

Finally, students address the biological aspects of limnology relating to Cascade Reservoir. Students run sophisticated fecal coliform analysis and microscopic and macroscopic examinations to identify and classify life forms. The class explores the water quality needs of each organism and develops a biological water quality index for Cascade Reservoir. Students may elect to do multimedia reports on their findings using video, computers, and sophisticated software.

At the culmination of this 13- to 18-week process, students have gained a working knowledge of the ecology of Cascade Reservoir.

Proposing Solutions

The course then enters its second phase: the identification of solutions to environmental problems related to the Cascade Reservoir. Students divide into self-chosen groups of three or four and are asked to identify and propose a practical and feasible solution to a specific aspect of the reservoir's eutrophication.

To accomplish this, they attend water quality meetings, give public testimony, write letters to government representatives, and use the Internet to do research and set up cooperative experiments with some of the world's leading experts. Students experiment on ideas they are researching and meet with experts to share information and get feedback on proposals.

Finally, groups present their proposal in the form of a 20-page report, including graphs, drawings, and a bibliography. They also make a 20- to 30-minute video on their project using high-tech editing equipment and software. As they formulate solutions, it is essential to stress that environmental problems can only be solved if one considers the science, economics, and politics of the problem and addresses these issues in a realistic way.

The Agony and the Ecstasy of the Biocoil

by Dani Gahl, a Former Sewage Sister

When someone says "Sewage Sisters," most people think of a foul-mouthed bunch of hooligan girls who either don't shower or don't swim in the proper lagoons. However, when I think of the Sewage Sisters, images of the worst, and best, two years of my life (so far) come to mind.

I remember realizing that after two years working on the Biocoil, three strangers had become friends. I remember getting really excited about something, excited enough to think that my innards were going to burst with anticipation, and I remember the way it felt when the excitement died with failure. I remember feeling like we were waiting for the apocalypse. Yeah, my emotions were completely jerked around.

Working on the Biocoil taught me science—limnology, botany, engineering—but I learned much more: the joys of working in a small group, the challenges of time management, the evils of procrastination, the tensions of public speaking, the art of the public bicker. Bureaucracy, loopholes, stonewalls, ignorance, hope, denial, disappointment, triumph—we covered it all.

I guess you could say that the project may have been too large an undertaking for a bunch of green high school students. Perhaps we rushed in "where angels fear to tread." We were taught things the hard, fast way, and maybe it was too soon, but I wouldn't change that.

Mr. Kennedy once said that they teach you what the world is supposed to be like in high school, and just before you graduate, they tell you the truth. Well, ignorance may be bliss, but it's still ignorance. I'm glad that I got the chance to take a crash course in reality before I head out into the real world.

The rewards of what we did seem slow to come. For a long time, I thought that personal satisfaction and a watch was all that I would get out of this deal. Of course, maybe for the lesson to be really useful, that's all that I should get. But despite my new cynicism (or should it be called realism?) I still have two fabulous and beautiful Biocoils, I have my pride, I have a renewed optimism—though this time it isn't blind— I have my personal satisfaction, and darn it, I have my watch.

Continued on next page.

Missing the Biocoil

by Tessie Gordon, a Former Sewage Sister

Something strange is happening—I actually miss the Biocoil. In May of my senior year of high school, I hated it and couldn't wait to run off to the big city where I would not have to hear, "Go run a phosphate test and don't forget to add nutrients today."

I looked forward to not spending every waking minute breathing, thinking, and living Biocoil. Instead of being known as "one of the girls who are making that sewage thing—a Sewage Sister," I wanted to be Tess, the independent, class-skipping, sewage-free college student. Let some other lowly high school student do the work for awhile.

But now I miss it. Now I study my brains out, and I don't see a thing in return.

At least with the Biocoil, I could work really hard, and when I was done, there stood the United States' first Biocoil. Or I could run 15 tests and when I was done, there were numbers that said this is working or add more "food." We could stay up until four in the morning working on a paper and get only three hours of sleep, but still be motivated to return to school by 7:30 to call England. There was something about hearing a British accent on the other end of the phone that made the whole trying situation worthwhile. Something that made the next late night tolerable.

Now, when I stay up until four and get only three hours of sleep, my only reward is a college lecture I barely manage to stay awake through and a busy day at work.

Now I realize there is something special about that Biocoil, and it's not just its algae. It taught me the value of hard work and a few important life lessons. Although I may never see the monetary rewards of my two years of work, I would be completely satisfied just to see working Biocoils in use, and perhaps someday, cleaner water. In fact, just knowing that I've done something that may someday make this world a better place is enough reward for me.

Taking Over the Biocoil

by Loren Jones and Kimberly Takeuchi

Students taking advanced biology at our high school create projects to actually do science, but what happens when students initiate a project that lasts for years? When those students graduate, new students have to take over that project, and when they graduate another batch of students must take over.

Last year, we took over the Biocoil, a photosynthetic bioreactor that uses chlorella algae to reduce nutrients in waste water. We are the third group to work on the Biocoil, and at first we felt overshadowed by the fame of the project. The Sewage Sisters had created a name for themselves and the Biocoil, and it was scary to make decisions that would affect it. Every other day, we went out and fed the Biocoil its regimen of nitrates and phosphates, and we checked the equipment, but we didn't feel ownership of the Biocoil. It just wasn't ours. We would like to explain how that changed for each of us.

Loren Jones:
I did not feel like the Biocoil was my project until one day when I was going to "pig" the Biocoil, clean out the tubes. I noticed that the pump wasn't pumping any water through the manifold and the tubing. After looking over the huge contraption, I noticed that one of the tubes was swelling from its original size of one inch in diameter to about two inches.

To see what was swelling the tube, I had to open the manifold and detach the tube. Suddenly, the pressure released and the tube flew off of the connector spraying me with treated sewage water, mixed with some chlorella

Continued on next page.

Once the solution process begins, students work on their own. This work includes a significant amount of research and preparation beyond the classroom. Students gain enough knowledge to attend professional meetings, understand what is going on, and make valuable contributions to the restoration effort.

Implementing Solutions

When students discover a viable solution to specific aspects of Cascade Reservoir's eutrophication, they begin the process of implementation. The students must first build support for their project within the community and from the professionals in the government agencies in charge of the management of Cascade Reservoir. This task involves altering various aspects of the proposal to meet specific requirements and regulations. Often, support from the groups directly responsible for the problem must be generated to convince them to change their land management practices.

Over the past several years, a number of students have successfully implemented their projects.

Two groups of students convinced ranchers and the Bureau of Reclamation to construct wetlands around the reservoir to remove nutrients from its watershed. Funding for these projects came through thousands of dollars in Phillips Petroleum Environmental Partnership grants in conjunction with the Idaho Fish and Game Department.

Another student proposed a creative approach to save the trout struggling to survive in the reservoir. After several meetings with the Department of Environmental Quality and the Cascade Reservoir Technical Advisory Committee, the project was approved and the student was awarded a $6,500 research contract to construct the project and publish the results.

A group of girls, who affectionately call themselves "The Sewage Sisters," spent almost two years researching and promoting cutting-edge technology being developed in England by a company called Biotechna. The students had engineers from England and California helping them via the Internet; they also attended many meetings to discuss

their research with political and environmental agencies. They generated public support and appeared on television, in newspapers, and in professional publications. This group received nearly $22,000 in grants from sources ranging from national organizations to local agencies to private citizens. The money was used to construct a mobile demonstration unit and collect data on its efficiency. (Editor's note: see the accompanying story, beginning on page 18, for students' views on the Biocoil Project.)

Ultimately, implementation of the solutions they propose is up to the students. If they can find the money and support, the advanced biology class will supply the place and the people. I guide and help the students, as do a number of qualified and dedicated individuals. Students are granted the opportunity to solve an environmental problem, and they respond with hard work and dedication.

Successes Bring Diverse Rewards

The success of the Cascade Reservoir Restoration Project is a testament to the impact a non-traditional teaching approach can have not only on the students involved but on the entire community and its natural environment. Students gain an amazing amount of respect for their capabilities from professional scientists, government officials, community members, national organizations, teachers, and themselves.

Students are more likely to work hard when completing projects they feel are worthwhile. Participating in projects of this caliber creates publicity that motivates students. For example, members of the advanced biology class have been featured on Boise area newscasts and the television program "Incredible Idaho." Students revel in the fame they receive and enjoy enthusiasm from the community. Younger students notice the publicity and are motivated to join the class as they get older.

A New Project: Learning, Planning, Hoping

by Jenny Whitehead, Ben Davidson, and Sarah Davis

The main reason that we decided to take advanced biology was so that we could put in to practice our prior book knowledge. It was important to us to be able to participate in a real-life science experience where we could interact with professionals in the field and work to better the environment we live in. Our work would also prepare us for college and possibly our future occupations.

Our project has to do with irrigation simulation. We are attempting to simulate flood and sprinkler irrigation in cattle grazing areas and also in natural environments. We have developed a process for percolating cow manure through soil using different types of irrigation and capturing the run-off to test phosphorus levels.

The point of our project is to find out what type of irrigation results in high amounts of phosphate escaping into watersheds. This, we have learned, is part of the process that polluted the Cascade Reservoir.

We have high hopes of applying our discoveries from this project to what takes place on a much larger scale in the uncontrolled environment. Eventually, we hope we can use our knowledge from this project to encourage one type of irrigation over another. But first we have to find out if one is indeed better than another.

Our advanced biology class has presented an awesome opportunity for us. It has helped create in us a desire to volunteer in projects that can truly better our environment and our own lives. ●

algae. Trying to slow down the flow of the water coming out of the tube, I reversed the direction of the water going through the manifold. Then I had to grab the solo tube and secure it to the connector. I took off my shirt, which was green with algae, and tied it over the tube as tightly as I could. Working quickly, I found a clamp, untied my shirt, slid the tube onto the connector, and then clamped the tube firmly to the connector.

After that, I headed off to Mr. Kennedy's house, to tell him about my recent Biocoil experience. When he opened the door, I can only imagine what went through his head at the unexpected sight (and smell).

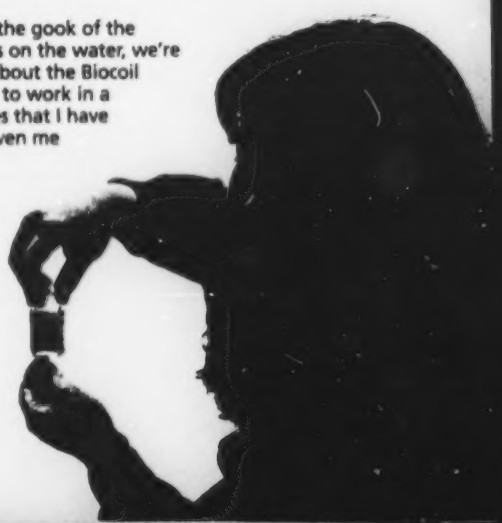
The first words I said to him were "I hate the Biocoil!" At that moment, when I was cold, wet, and completely miserable, I knew the project was mine.

Kim Takeuchi:

Loren may have gotten attached to the Biocoil a little faster than I because I haven't spent as much time in the mess of the sewer pond as he has. At first, going out to the Biocoil to learn from the old group members was interesting, yet frustrating, because the concept and process of the Biocoil was a little difficult to understand.

I found it took awhile until I felt comfortable working on the project without feeling the pressure of the old members. Eventually, I realized that I learn best working outdoors. I feel that I am learning about ways of helping the environment and, at the same time, making our project better. Just getting away from school for a short time when we check the Biocoil makes my day a little better.

Whether we are working in the gook of the sewage ponds or taking tests on the water, we're always learning. It may be about the Biocoil itself, or politics, or just how to work in a group. All of the experiences that I have had with the Biocoil have given me a kind of connection to it. Now the project is truly mine. ●



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Traditional—Reform Pedagogy Continuum

Predominance of Old Orientation

Teacher Role: *As dispenser of knowledge*

- Transmits information
- Directs student actions
- Teacher's knowledge is static
- Communicates with individuals
- Explains conceptual relationships
- Directed use of textbook, etc.

Student Role: *As passive receiver*

- Records teacher's information
- Follows teacher directions
- Memorizes information
- Defers to teacher as authority

Student Work: *Teacher-prescribed activities*

- Emphasizes worksheets
- Teacher directs tasks
- All students complete same tasks
- Absence of items in New Orientation

Predominance of New Orientation

Teacher Role: *As coach and facilitator*

- Helps students process information
- Coaches student actions
- Models the learning process
- Communicates with groups
- Facilitates student thinking
- Flexible use of materials

Student Role: *As self-directed learner*

- Processes information
- Designs own activities
- Interprets, explains, hypothesizes
- Shares authority for answers

Student Work: *Student-directed learning*

- Directs own learning
- Designs and directs own tasks
- Tasks vary among students
- Emphasizes reasoning, reading and writing for meaning, solving problems, building from existing cognitive structures, and explaining complex problems

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When a Project Fails

by Betsy Shotton, April Haskins, & Jessica Byrd

In the Sewage Sister Biocoil project, which generated much interest in our community, the majority of the questions asked were related to sewage treatment. Our project was based on a different question: "If ingesting algae from the Biocoil is beneficial to the health of cattle, is there a way to grow algae that is safe for humans to consume?" In other words, is it possible to produce algae in the Biocoil with tap or distilled water rather than sewage water?

The health food market for algae and herbs is growing fast. Stores that sell such algae harvest it directly from a lake, dry it out, and bottle it. However, many people are interested in growing algae in their own homes. With this interest in mind, we reengineered the Sewage Sisters' Biocoil to produce edible algae.

The design of our Biocoil had to be eye appealing and easy to maintain so that people would want to keep such a system in their home. Furthermore, the system had to have the capacity to produce enough algae every day so that it was more cost effective than buying algae from a store. Most important, the algae produced had to be edible and not toxic. After all, people eat algae to improve their health. Thus, a liability variable was introduced into our project.

It was this aspect of our project that proved to be the most difficult to overcome. For the system to remain sterile, we had to use pure elements—distilled water and uncontaminated algae. We had to feed the Biocoil nutrients while keeping the system as airtight as possible. This is not an easy task when you consider that for photosynthesis to occur, the algae must have a source of carbon dioxide and be able to rid itself of oxygen. Of course, the outlet for oxygen allowed air to enter the system, thus making it vulnerable to contamination.

Unfortunately, after two years of work on our project and repeated incidents of bacterial contamination, our Biocoil had a minor, but fatal explosion. This was the final straw; we decided that our system was too vulnerable to human error, that the possibility of producing toxic algae was too high.

We did not arrive at this decision lightly. It meant giving up two years of hard work to start from scratch on a new project. In the end, however, we knew it was the best decision. ●

Motivation likewise increases when students are rewarded for their efforts with scholarships, grants, and awards from competitions. Students taking advanced biology have won a multitude of scholarships by consistently placing among the top five national finalists in the Seiko Youth Challenge Environmental Action contest.

Perhaps the most rewarding motivator comes with the actual implementation of the projects. Students feel a sense of pride that their proposals are practical, valid, and sought after by professionals.

One of the most important outcomes is the actual restoration of Cascade Reservoir. Student ideas that have been implemented are providing valuable studies concerning the most effective techniques for improving the water quality of the reservoir. Student interest has forced the community to become aware of the extent of water quality problems; these young people are challenging political powers to address environmental issues. As awareness spreads through publicity, those in charge of protecting the environment are pressured to do more rather than less. Our successes have also stimulated students in other communities to address similar environmental problems.

As a teacher, my experiences with the Cascade Reservoir Restoration Project have taught me two things about educating young people: never underestimate their ability to accomplish difficult tasks and never hold them back. Give your students the freedom to explore the world and be creative. Their insight can provide solutions that adults overlook. ●

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Project Snoop Troop

Cultivates a Community of Learners

Parents, teachers, and community members work together to bring excitement to learning math and science in this K-3 school.

by Julia Harris, ENC Publishing

What does a scientist do? What is soil made of? What is a map? What is a wetland? Why is an apple tree growing in Cedar Swamp?

Young children are full of questions. Sometimes it can become exhausting—and intimidating—if we don't know the answers. And yet it is through such inquisitiveness that students acquire knowledge about the world around them, as well as their place in it. Parents and teachers can help foster that spirit of inquiry by taking those questions seriously and venturing with children on journeys of exploration.

Hastings Elementary School in Westborough, Massachusetts, a K-3 school serving a multicultural population of approximately 630 students, has come up with an innovative and award-winning program designed to do just that. In 1994, says principal Nancy Spitulnik, "Three parents came to me very concerned that the school was doing a lot in the area of language arts, but we weren't really focusing on math and science. Science especially seems to be the neglected step-child in the elementary school."

To remedy this situation, a group of parents, teachers, and administrators got together to create Project Snoop Troop, a three-tiered enrichment program designed to provide hands-on, inquiry-based lessons and courses to enhance students' experiences in math, science, and technology. The name of the project was chosen by one of the parents in the group to convey the idea of students actively investigating the world around them. Launched with an initial grant of $13,000 from the Center for the Enhancement of Math and Science Education at Northeastern University, along with support from the school's parent association and local businesses, Project Snoop Troop provides enrichment opportunities for the classroom, maintains a resource center of hands-on materials, and involves students in a series of after-school mini-courses taught by parents and community members.

The Importance of Community

The school has always enjoyed a high level of involvement from parents and the community, and Spitulnik notes "parents are very creative in coming up with courses." Participants in each course meet four times during the term, generally

Trooping Through Cedar Swamp

Hastings School is fortunate to have Cedar Swamp, designated an Area of Critical Environmental Concern, quite literally in its backyard. "There are animals living there that are on the endangered species list," explains the school's science coordinator, Carol Burtt Borglund. "It is also the headwaters of the Assabet River, which is, I think, one of the few rivers in the world that flow north. So there is a lot out there."

Needless to say, Borglund saw this as a great opportunity for classroom teachers and for Project Snoop Troop courses. She took classes of second-grade students on explorations through the swamp in which they used all their senses to fully experience the environment.

For the third-graders, Borglund decided to build on their preexisting mapping unit and invite a watershed ranger to come in and talk about the use of topographic maps. Students compared road maps with topographic maps of their own hometown of Westborough. They also built their own watersheds by crumpling up newspaper in aluminum baking pans, covering their "landscapes" in plastic wrap, and spraying over the top of it with water that had been dyed blue. The water would run over the "hills" of the newspaper and drip down into the valleys, providing a very handy model of a watershed.

One inquiry that arose from the exploration of Cedar Swamp involved the unexpected discovery of an apple tree growing in the middle of the wetland area. "Second-graders discovered this tree, and we wondered how it got there and how it was surviving. We went to the historical society and found a map from 1836 that showed that the area had once been a farm. Then our county forester came and bored the tree for us so we could find out its age by reading the rings, and we found that it was about 65 years old. We said, 'How can this be a wetland with an apple tree here?' That was our open-ended question."

To answer this question, the third-graders invited Stafford Madison, Regional Outreach Coordinator for the Environmental Protection Agency, to come into their classroom and analyze soil samples with them. "She talked about how to tell the difference between upland soil and wetland soil," Borglund says. Observing soil profiles taken from the swamp and the schoolyard, the children were able to discuss where they thought the boundaries were and where the samples had been taken. With the children involved in the after-school Project Snoop Troop course, Madison went into the swamp with an auger and helped the students pull up and test their own soil samples.

The interaction the students had with Stafford Madison was valuable in more ways than Borglund could have anticipated. As she relates, "I had prepped the students the day before about Stafford's visit, telling them that a scientist from the Environmental Protection Agency was going to talk to them about Cedar Swamp. Then, when Stafford walked into the classroom the next day, a girl turned around and said loudly to everyone, 'She's a she! The scientist is a she!'" Borglund laughs. "That girl was part of the after-school class and stuck to Stafford like a magnet. She proclaimed to her mother that she wanted to be a scientist when she grew up. She'd had no idea that girls could be scientists!" ●

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for one hour after school. Past courses have included Chemistry in the Kitchen, an introduction to the chemical reactions that go on between the ingredients used in cooking; Flying Things: Rockets, Planes, UFOs, and More, which gives students hands-on experience examining rockets, finding out how a hot air balloon flies, and exploring parachutes, goggles, and other aerial paraphernalia; and the Project Snoop Troop Chess Club, in which students learn how to play chess. Other courses include Playground Physics, Hands-on Computers, Ant Antics, and Math Games and Puzzles. "There are so many people out there in the community who can be brought in to work with the students," Spitulnik comments. "And this is the age to get the kids involved and to get them excited about things like this, because they are so open to it."

In its first year, Project Snoop Troop attracted almost 300 students to these after-school courses. Since 1994, there have been more than 100 courses, all led by volunteers from the community. The school has also benefited from a partnership with a local school, the Assabet Valley Vocational High School, which has allowed Hastings students to attend drafting, electronics, graphic design, and horticulture classes. "We have never had trouble getting kids interested in coming to the after-school classes," says Spitulnik. "If anything, we have had to pack in more kids than we were really comfortable with because we didn't want to deny anyone the chance to come."

Because of the program's overwhelming success with students and parents, in 1996 the school hired a part-time science coordinator, Carol Burtt Borglund, to oversee the program and to work with teachers to incorporate enrichment activities into their classrooms. "At the time I came on board, the after-school component had really taken off; the weak link seemed to be in bringing it back into the classroom and coordinating the after-school activities with what was going on in the curriculum," explains Borglund. She found that one of the crucial issues teachers faced was, not surprisingly, a lack of time.

Borglund discovered that one way she could help the Hastings faculty inject more math and science into their existing curriculum was to work closely with them in their classrooms, modeling lessons for them and helping them develop their own lessons. In her classroom presentations, she provided lessons, handouts, and hands-on activities that connected the material to the curriculum units. She also worked to gather materials and supplies teachers would need in a hands-on inquiry. Borglund scoured the community for people who would be willing to come into the classroom and interact with the children, bringing in park rangers, beekeepers, and even a representative from the Environmental Protection Agency to come in and do soil mapping with third-grade students.

How Does Your Garden Grow?

One of the ways Borglund worked with teachers to bridge the gap between the after-school courses and the classroom was through a schoolyard garden project. "I inherited a garden that had only been used by the after-school students—it was called the Pumpkin Patch," she says. "Well, the first-grade curriculum calls for the complete understanding of the growth and parts of a plant. What teachers had been doing was planting seeds in individual pots and putting them on their windowsills. We worked together to develop a project where the first-graders could plant seeds in the garden by April 1 and harvest their crops on the last day of school." In addition to the garden, children grew bean sprouts on their classroom window sills, and at the end of the year they made classroom salads with their sprouts and the spinach, peas, lettuce, and radishes they had grown in their garden.

This project spawned a number of classroom applications for the seven first-grade classrooms, as well as for the other grade levels. For example, first-grade students learned about the components of soil by participating in an activity to make their own soil. "It was conducted like a cooking class," Borglund explains. "They had 'recipes' for soil, things they could choose from to put into a bag. Things like tin cans, pieces of aluminum, plastic straws, as well as the stones and leaves and things they had collected from outside. They put these things into their bags and shook them up and down. They predicted which items would turn into soil and which would not. Of course, it takes 500 years to make one inch of soil, so the missing element was time. That was part of the lesson of making the soil."

The students also learned about making compost in plastic bags, which they then deposited in their garden. A representative from REAPS, a national recycling program, conducted a professional development workshop for teachers and used worms to show how they work to break down the soil. Borglund then bought a thousand red worms for the school, and the Assabet Valley Vocational School built a worm observation tank that circulated from classroom to classroom. Feeding and caring for the worms included reciting a rap: "No bones, no bones, no bones, a worm ain't got no bones," and so forth about how the worm has no eyes, no feet, and no teeth. After each classroom had the tank for about a month, the worms were deposited in the garden to be rototilled with almost 150 children watching and singing their worm rap.

For the second and third graders, the schoolyard garden evolved into a unit to enhance the second graders' study of the pilgrims and the third graders' Fall Feast. By contacting Plimouth Plantation, a recreation of a pilgrim village near Plymouth, Massachusetts, Borglund researched what the pilgrims ate and how they had structured their gardens, as well as the agricultural methods of the Wampanoag Indians, the tribe that helped the colonists survive. She notes, "The project focused on an open-ended investigation: 'It is springtime in

the year 1627 and you live in Plimouth Plantation. What crops will you plant to feed your family if you are a Wampanoag or a Pilgrim?'"

Lumber donated by local lumberyards and labor provided by students at the Assabet Valley Vocational School were used to create replicated gardens at Hastings. Two parents volunteered to lead the after-school classes in gardening practices. They also joined Borglund in watering the gardens throughout the summer. By the beginning of the next school year, authentic seventeenth century plants—including yarrow, mint, jerusalem artichokes, skirrets, beets, onions, cabbage, thyme, sage, tansy, and scallions—were available for students to use their five senses to explore. Plants were sorted by characteristics using Venn diagrams. Second- and third-graders ground their own corn using stones and wooden bowls as mortar and pestle, and enough corn meal was created to make bread.

Advice to Others

How Does Your Garden Grow? is only one example of the influence Project Snoop Troop has had on the population of Hastings School. (See sidebar on page 23.) Although not every school is within convenient range of a facility such as Plimouth Plantation, Project Snoop Troop illustrates that the community around any school can provide a wealth of real-world learning experiences for students of all ages. "Parents are huge resources," Borglund insists. "Their involvement has ranged from assisting in the classroom, to sharing their knowledge in an after-school course, to contributing unique supplies such as raw cotton from a farm in Virginia. We found that the help of parents was really vital."

Principal Nancy Spitulnik agrees. "The thing that really impressed me the most was the community effort and how it brought the community together. The teachers were involved. The parents were very, very involved. We've had the parent group donate funds, we've gotten funds from the local community, we've written grants. Also, the science coordinator was able to bring in some incredible community people that we never would have known about." She stresses the importance of having someone like Borglund, even if only on a part-time basis, who can work with teachers to provide resources, help with the lessons, and organize the after-school sessions. "I think classroom teachers may want to do some of these things, but they just don't have the time. I think the school has to decide that it is a priority for them."

Unfortunately, even with all the help from the parents and the community, Project Snoop Troop has had increasing difficulty in finding funds. Last year, the program was forced to start charging students $10 to attend the after-school sessions, which has cut enrollment. Spitulnik continues to write grants and seek outside help, citing Project Snoop Troop's many successes. In 1996-97 and again in 1997-1998, the program received a Certificate of Excellence for Environmental Education from the Commonwealth of Massachusetts Secretary of Environmental Affairs. The program has recently received an Innovations in Teaching award from Intel Massachusetts.

She endorses the program with an almost missionary zeal. "I think we underestimate sometimes what kids are able to do. Sometimes we stifle them by not giving them opportunities that will challenge them," she says. "This is one area where we have seen them go beyond what we expected. The kids are excited, the teachers are excited, the adults who work with the kids are excited—and that excitement influences the way teachers teach. I think that is as important as the kids getting something out of it, because then teachers change the way they teach and that affects every other child who goes through their classroom." ◉

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From a Parent's Point of View

Leslie Chen is the mother of Frank and Eddie, two "veterans" of Project Snoop Troop. Although her boys are no longer at Hastings—Frank is now in seventh grade and Eddie is in fourth—Chen remains a fervent supporter of the program.

When asked to describe some of the boys' favorite Project Snoop Troop courses, she identifies Navigation on the Snoop Troop Seas as one Frank particularly enjoyed. He learned to draw maps and charts and how to determine direction from the constellations. She was able to participate in the course as a parent volunteer, staffing one of the hands-on stations and helping the students complete their activities. And as for Eddie, Chen's younger son, the highlight would have to be the Cedar Swamp Walk, from which he would come home in the afternoons very dirty but even more excited about the kinds of bugs and plants he had seen.

"I found that the program really motivated my boys to find out why and how things happen. It helped them develop an interest in science," she notes. "They were always very enthusiastic about their courses, so whenever there was another one coming up, I always made sure to sign them up!"

One of the most rewarding things about the program, Chen explains, is the way the children were expected to share what they had learned in the after-school courses with their classmates during the regular school day. She was also encouraged by the level of involvement that she saw from the parents and the community members. "Parents were instilling their professional knowledge into the school environment. It was like adding another dimension to the curriculum, which I found to be very interesting," she says.

Chen was inspired to use some of the techniques she saw in the Project Snoop Troop courses in her own work as a Chinese language instructor for approximately 150 children. "Project Snoop Troop showed me that parents' involvement is very important, and it gave me the idea to have parents come into my classroom and share about their heritage and cultural celebrations." ◉

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Petals Around the Rose

Building Positive Attitudes About Problem Solving

Middle school students take charge of their own learning once this math teacher presents an intriguing puzzle.

by Marie Appleby, Mathematics Teacher, South Hadley Middle School, South Hadley, Massachusetts

The sound of five rolling dice caught everyone's attention.

I continued rolling the dice until a small group of curious students gathered around me.

"What are you doing?" asked Sarah.

"What do you think she's doing? She's playing with dice!" croaked Danny disdainfully.

With a gleam in my eye but keeping a straight face, I started my routine:

"The name of the game is Petals Around the Rose. The name is very important. For each roll of the dice, there is one answer, and I will tell you that answer."

I rolled the dice.

"The answer is four," I said without changing expression.

I paused and then rolled the dice again. "The answer is ten."

"How did you get that?" asked Sarah suspiciously.

"You must be a mind reader or something," chimed in Jamie.

"Can I roll the dice next?" asked Danny, trying to take control of the situation. Danny rolled the dice three times, and I gave only answers.

"Six."

"Ten."

"Zero"

By this time, the students were hooked. Here were materials they knew very well but presented in a way that was new to them.

Early in each school year, I want my students to examine the methods they use to approach problem solving. The Petals Around the Rose problem confronts students with a lot of data and an answer, but no formal question and no explicit conditions of the problem. Since this problem requires only a little time to set up, I start it during the last five or 10 minutes of a class when we've finished our lesson for the day. The game continues in and out of class whenever there is transition time.

I am always intrigued by the observations students make and about the hypotheses they sometimes mutter out loud. I do want them to be observant—to check for similarities and differences in the outcomes of the rolls of the dice—and to generate many possible explanations or rules for the game. I also want them to feel the joy of working on a seemingly difficult problem in math and solving it. More importantly, I want them to begin making judgments about right and wrong solutions without depending on the teacher for verification.

The introduction of the game described here was done in early October with one of my classes, a heterogeneous mix of 25 very energetic seventh grade students.

After a few rolls giving only the answer, I repeated the routine:

"The name of the game is Petals Around the Rose. The name is very important. For each roll of the dice, there is one answer, and I will tell you that answer."

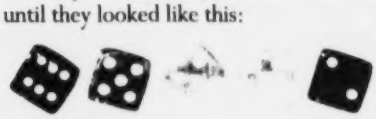
I rolled the dice.

"The answer is six."

Jamie picked up the die with four facing up and moved it to the other end of the line. "Now, what's the answer?" she asked.

"Six," I replied.

With a puzzled look, Jamie then moved several other dice around until they looked like this:



"Now what?" she wanted to know.

Again I said, "Six."

Then the bell rang ending class, and I agreed to continue the game another time.

Two days later, there was an opportunity to continue the game.

"Can we play Petals Around the Rose?" asked Jamie.

Her question was quickly followed by a chorus of "Can we?" from nearby students.

"Okay," I agreed and pulled the dice out of my pocket. I started the routine:
"The name of the game is Petals Around the Rose. The name is very important. For each roll of the dice, there is one answer, and I will tell you that answer."

I rolled the dice.

"Eight."

"There's no eight there!" moaned Jamie.

"You didn't tell us the rules," wailed Danny.

As if not hearing, I repeated,
"The name of the game is Petals Around the Rose. The name is very important. For each roll of the dice, there is one answer, and I will tell you that answer."

I rolled the dice.

"Six."

"Zero."

Looking at my students' puzzled faces, I thought back to how I had learned the game at an educational conference. While some colleagues and I were waiting for dinner one evening, the head of our math committee pulled out five dice from her pocket and started rolling them. She repeated the same directions and kept a noncommittal face.

My colleagues included teachers from language arts, social studies, science, and industrial arts, and we were all trying to figure out how the answer fit the name. It was aggravating. I remember trying many different possibilities including combining dice in arithmetic ways, disregarding some dice, looking for patterns in the way dice landed, and on and on.

The language arts teacher, an admitted mathophobe, was the first to find success. I admit I wondered what he had tried that worked so easily. Finally, I decided to try something simpler—something that had to do with "around" in a different way than moving the dice. The "ah-ha" feeling that hit me when I saw the Rose and the Petals around it was wonderful and gratifying. I decided that feeling was something every student should experience. I've played the game with my classes every two years since then.

When guesses from my students started flying fast and furiously and seemingly without much thought, I decided to halt the game and asked the students to look at what was happening. There would be no more playing of the game that day, but I asked, "What do we know about Petals Around the Rose?"

As the students generated a list, I wrote the items on the board, as I do with other investigations:

1. The name of the game is Petals Around the Rose.
2. Use five dice with dots.
3. We know the answers.
4. The color of dice is not important.
5. It has something to do with "around."
6. Roll the dice to get answers.
7. All answers are even.
8. Focus on what is the Rose.

It was clear that some of the items in this list were straight observations on a concrete level while others showed that some students were beginning to describe areas to explore.

The students then went to the board and drew pictures of sample dice rolls. After writing the answers to the rolls, I asked the students to write the list and the samples in their journals and to think about them. When there was time in the next few days, we would try Petals Around the Rose again.

The First Solution

The next day Ted arrived first to class and said, "Test me! Test me about Petals Around the Rose. I think I've got it!"

Listening to his excited voice and noting his early arrival to class, I pulled out the dice and repeated the routine. I rolled the dice three times and he spoke the correct answer each time before I could say anything. I only nodded my head. With each answer he became more confident. After the third roll, I declared him to be "Potentate of the Rose, one all-knowing about Petals Around the Rose and sworn to secrecy about the method."

Ted was well liked and a hard worker but not the star of the math class. While his "test" was going on, the other students came into class and were both surprised and delighted that he had found a solution. I handed the dice to Ted, and he ran the game for the next ten minutes with small groups of students while other students and I were getting organized for the class.

During the next few days, Ted had a chance to "test" other students. They kept asking him to explain how to get the answer, but he always kept his secret. He brought his own dice, and I noticed his classmates cornering him in the lunchroom and during homeroom to practice. After about one week of working with Ted in many out-of-math-class practices, about one-third of the class had managed to figure out a method. Each new "Potentate" seemed to be just as pleased as Ted, and, I hoped, just as protec-

Student Journal Entries

In early December, I asked my students to "tell me in writing where you are with Petals Around the Rose." I enjoyed their honesty and their willingness to share. Their writing convinced me that they enjoyed the problem and were beginning to have a positive view of their own ability to solve problems, even if they had not solved this problem.

Several of the student responses are provided here. The spelling and grammar are uncorrected. *(Editor's note: If the game still mystifies you, look for clues in the students' thinking!)*

I was very excited when I had found the solution to this problem because I hadto find out soon it was really buging me.

I solved petals around the rose. At first it was hard, but it got easier. I learned during home room. It took me half the period, but I did figure it out. I'm really glad I figures it out because now I can participate in the game.

I think this is a fun game because it challenges you and then you can't stop thinking of a way to solve it.

I like the petels around the rose. I think it's fun for now I understand it. I never taught math could be fun. I guess I was wrong. Petels around the Rose is fun, for all you have to do is count the number of dots around the dot in the middle. I taught it was hard to understand at first but now its fun.

I have no idea how to do this. I can almost do it with 2 but only sometimes. I know that it has something to do with odd & even numbers I think. I can't wait to find out how to do this. So far I think this is pretty cool.

I don't know how to do Pedals Around the Rose but I'm determined to find the soloution. I think the soloution lies in the numbers 3 and 5 but I have yet to figure it out. I very am very, very, very, detirmined to find the soloution and well.

I solved peddels aound the Rose a long time ago. 3 and 5 are the only numburs that mean eneything. the dot in the middle is the rose, and the dots on the out side are one each. I like peddals around the rose but it is agrivating if you donot know how to do it.

tive of each person's right to discover the method rather than be told.

As each day passed, I felt the excitement within me grow as I watched more and more students solving Petals Around the Rose. Since so many students now knew the method for the game, I was not needed to run it. Instead, students could pick up a set of dice from the materials table and help small groups at the beginning or end of class or any transition time in between. The game was no longer mine—it belonged to the students.

Karen's Emergence

Near the end of October, I introduced Petals Around the Rose to my other two math classes and found a pleasant surprise in one of them. Karen, very shy, conscientious girl who hardly spoke in class, started giving answers to the first few rolls of the dice. When I asked her how she knew the game already, she explained that Tamika from Ted's class had spent more than an hour working on the game with her during the previous weekend.

She and I split the class into two groups for the initial rolls. What a boost for Karen's confidence! With such a promising start, I thought that this class would probably take ownership of the problem in a shorter period than the other class. Although not as many students had discovered the method within a week as compared to the first class, the game was being run by the students starting with the second day.

Alice's Discovery

Alice was a special education student who was beginning to grow mathematically. She was mainstreamed along with four others into a regular math class while continuing to receive support from Ms. Dowling, the special education teacher who co-teaches the class with me.

Aware of her difficulties with mathematics, Alice was nonetheless convinced that she could succeed as long as she had enough time to develop her own understanding of the concepts. Time and again, I watched her steadfastly tackle problems—sometimes with a partner, sometimes with help from Ms. Dowling, but mostly on her own—and work at them until she was satisfied.

Alice approached me one day to ask about Petals Around the Rose. At this point, not quite half of the class had mastered the game. Alice seemed intent on finding a method so I repeated, *"The name of the game is Petals Around the Rose. The name is very important. For each roll of the dice, there is one answer, and I will tell you that answer."*

After five rolls, she stopped me and in a confused voice said, "I just don't see it. The five dice don't give the answer you call no matter how I add or subtract them. It's too confusing."

I decided to probe her ideas. "Before we go any further, tell me what you know about the game."

"The name of the game is Petals Around the Rose. The name is very important. For each roll of the dice, there is one answer."
She smiled at her own sing-song repetition of a very familiar line, but then with eyes wide and a finger pointed at the dice, she remembered, "The answer's always even."

She paused and I waited. Finally, she said, "There's just too many dice. I can't keep track of five dice. Does the game have to be played with five dice?"

I thought, "What a great question!" I wondered why no other student had asked about that. I was also pleased that Alice was applying one of the problem-solving strategies that her class had generated as useful: make the problem simpler.

Aloud I answered, "No. How many dice would you like me to use?"

After thinking for a few seconds, she answered, "Two."

I began rolling only two dice following the same routine. After the sixth roll, Alice became excited and began to give the answers simultaneously with me right through the ninth roll.

She then urged me, "Do it with three dice."

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I rolled three dice several times and then moved to five dice. Alice kept giving the correct answer. After three trials with five dice, she announced, "I've got it!"

Her smile was broad and infectious, and I thought she would dance around the room. She did a few hops and skips back to her seat and then energetically but gently cajoled her partner to try the game.

Alice's patience and gentleness were in evidence the next few days as she worked with her partner and Ms. Dowling, both of whom did not have a solution. When I heard the "I've got it!" rising from Ms. Dowling on the other side of the room, I knew that Alice had been at work.

Later, Ms. Dowling confided that Alice had offered to make the problem simpler by using only two dice. Alice had kept the secret of how to do the game but was willing to share her strategy to help others. Other students who had not yet found a method found their way to Alice's side and in the process developed a new respect for Alice.

Satisfying Strategies

Petals Around the Rose is a problem in game form that students at all levels (and all ages) can attack and can solve. Of course, there are other activities—many of them specifically tied to the math curriculum—that carry students to an ah-ha discovery or experience. However, Petals Around the Rose offers a change of pace, a non-traditional problem that engages the students in light-hearted activity while requiring them to use several important strategies:

- guess and check,
- make a list of known facts,
- draw samples or diagrams,
- write ideas in a journal, and
- make the problem simpler.

Petals Around the Rose has developed a feeling of success and power in the students and a positive view of problem solving. ●

This is Marie Appleby's thirtieth year teaching seventh- and eighth-grade mathematics at South Hadley Middle School in South Hadley, Massachusetts. She has been involved with curriculum and staff development within the school system and has been on the staff of SummerMath for Teachers Institutes at Mount Holyoke College in South Hadley.

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A New Game

Mancala Board with 12 Pockets

Mia and Kara, the inseparable duo in my homeroom, had another surprise for me.

"Do you want to play our Petals Around the Rose game?" they asked, approaching me with mancala board and two handfuls of marbles. I was intrigued.

They splashed the marbles onto the board and then looked at it intently. After a few seconds, they looked at each other, gave a signal, and simultaneously said, "Five."

This is how the board looked.

I didn't have a clue.

They gathered all the marbles together and then repeated the process.

"Seven. Do you get it?"

It took me about a dozen tries to figure out the rule that they had devised. I used the same process of making a hypothesis and testing as I had used when I first learned Petals Around the Rose.

The method that finally tested true was to count one for each space that held exactly one marble. (It is important to know that my homeroom played various versions of mancala on a regular basis and that spaces that contain exactly one marble are important for capturing in the game.) The girls took their game to classmates around the room and stumped almost everyone.

Later, when the other students had gone to lunch, Kara and Mia stayed to talk to me privately. I had not asked them to stay, but they wanted to explain the origin and design of their game. They had analyzed Petals Around the Rose and decided that they could create a game based on a single rule and run it the same way as I had.

When I mentioned that the name Petals Around the Rose did not really relate to their rule, they agreed but Kara said, "The name isn't as important as looking for the rule in our game. When we say Petals Around the Rose, everybody expects to look for a rule now."

STILL PUZZLED?

The Student Journal Entries (p.28) provide the solution to Petals Around the Rose.

ROLL WITH IT:

An Activity Integrating Mathematics and Science

How might inquiry look in a real classroom? In this activity from Bill Heinmiller's classroom, students are given a prompt, a question that gives the rationale for the investigation. The students are expected to first decide how to investigate the question, then design the experiment themselves, ask for any equipment they may need, collect the data they consider relevant, and, finally, present their results. This is decidedly not guided discovery but open inquiry!

by Bill Heinmiller, Science Teacher, Westerville, Ohio

Grade Level 7-12

In this activity, science and math concepts are "rolled together" through a problem-solving activity with toy cars. After spending several minutes experimenting with rolling their cars down ramps at different heights and angles, the students decide three tests to perform on their cars. Student groups will earn points for successfully completing these tests.

Student Background

To successfully participate in this activity, students should

- have an understanding of angle measurement.
- be able to measure distances in metric units.
- be able to organize and record data collected in lab.
- be able to graphically represent data.

Teacher Background

Analyzing motion of objects is one of the most basic scientific activities we can have our students do. Yet, through this analysis our students will explore the most revealing laws of physics. Some of the basic physical ideas and laws encountered in this activity are:

friction: The force that occurs between objects in contact with each other. Friction always acts in the opposite direction from motion.

speed: The ratio of distance traveled to time elapsed.

velocity: The ratio of distance traveled in a specific direction to time elapsed.

acceleration: The rate at which the velocity of an object changes over time. When the velocity is decreasing, the acceleration will have a negative value and is sometimes called deceleration.

In this activity, students experiment with factors that may have an influence on stopping distances. All of the factors above, as well as others, may influence stopping distances. For example, the friction between the car and a freshly waxed floor is different than that of a carpeted floor. Cars with greater velocities require greater stopping distances.

After completing their data collection, students then analyze their data in a variety of ways. These may include, but are not limited to, the calculation of mean, median, and mode; graphing their results; compiling a table of results; and a variety of other techniques as determined by the students.

Depending on the readiness of the students, analysis of the data will vary. For example, it may be appropriate for middle school students to qualitatively explore and predict the factors that might influence stopping distances, while high school physics students would use quantitative data to calculate the coefficient of friction, the deceleration rate of the car, or the acceleration rate of the car as it descends the ramp.

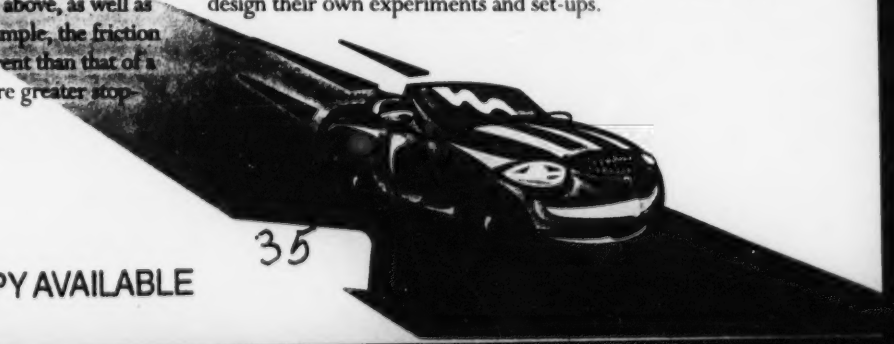
The possibilities are endless. I have had students explore the influence of ramp angle upon the acceleration of a car as it travels down the track. These data can be used to extrapolate the acceleration of gravity (i.e., angle of 90°). Explorations such as these can lead to rich discussions of the fundamental principles of physics.

Materials

Each group of students may request all or some of the following supplies:

- Matchbox (or similar) type toy car
- Stopwatch
- Ramp (approximately 1 meter in length or longer)
- Meter stick
- Protractors
- Calculators
- Graph paper
- Balance
- Weights or coins to attach to the cars

I use a Hotwheels set called G-Force that works very well and costs $10 to $12. The set includes a ramp, loop, connectors, clamps, etc. I throw away the box and directions and let the students design their own experiments and set-ups.



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Note: Your students will probably request some supplies not listed above. Every time I do this activity, my students make a new request. If you have students make requests the day before the activity, you will have a better chance of honoring their requests. Better yet, have them find some materials on their own.

The Prompt

You may begin by telling them they are a driver of a race car, but there is an annoying problem with their car—it has no brakes!! At this point, students may wish to begin exploring some of the variables that influence the stopping distances for their car. They may explore variables such as ramp height, angle of the incline, surface, etc.

Another possibility is to simply tell students to design an experiment in which they will collect data for their car. After this time, they will be expected to make a prediction about how their car will behave in an unexplored set of circumstances. You may vary this based on the level of your students.

The Warm-Up

Allow the students to brainstorm for five to 10 minutes about their proposed experiment. At the end of this time, they should present to you a list of materials needed to conduct their experiment (see materials section).

The Investigation

The students are given a set amount of time to explore the stopping characteristics of their car as they alter one variable at a time. The variables may include surface, angle of ramp, height on ramp, or other variables limited only by the students' creativity.

During the experimental period, students should collect enough data to calculate the mean, median, mode, and range of results for each variable they explore. Students may decide that a graph of their data may help them in their analysis of data. Students should organize their data in tables and represent their results graphically.

Student thinking about their data should include both an in-depth analysis of each type of measurement (e.g., finding the mean, median, and mode of stopping distances) as well as a search for any correlation that may exist between the different types of measurements. It is important for students to realize that they must be able to show how they arrived at their predictions for stopping distances and other findings.

Assessment Suggestions

Students may be assessed in a variety of ways:

1. Have each group member write several paragraphs that address the following:
   - Experimental design
   - Results
   - Prediction based on these results
   - Results of the prediction
   - Suggestion for further experiments

2. Have students present their group results to the rest of the class.

3. Some further evaluation suggestions are included in the extensions below.

Extensions

Depending on the grade level, this activity may lead to several follow-up activities. Some possibilities include:

1. Calculation of average velocity as the car rolls down the plane.
   Vavg = total distance / time elapsed
   Vfinal = Vavg x 2 (if acceleration is uniform: i.e., constant slope)

2. Calculation of acceleration, *a*, as the car rolls down the plane.
   a = (Vfinal - Vinitial) / time elapsed

3. Calculation of acceleration, *a*, as the car rolls to a stop.
   a = (Vfinal - Vinitial) / time elapsed

   Note: In this case, the value for *a* will be negative because the car is slowing down. This is called deceleration. It is important for the initial velocity for this calculation to be taken when the car begins to slow down (for example, at the bottom of the ramp).

4. Design a competition in which students must figure out how to make their cars behave in a certain way. Here are some suggestions for the competition:
   - Make the car come to a stop on top of a hill.
   - Make the car stop in a designated "pit" area.
   - Make the car stop as close to the edge of a "cliff" as possible.

   I have found that allowing students to determine their own investigation and competition works very well in my classroom.

5. Further experimentation may include a look at the relationship between the height from which the car was released compared with the height it may reach on an adjacent incline. Several variables may be explored here and may lead to an interesting discussion. ●

Bill Heinmiller teaches general science and physics at Westerville South High School in Westerville, Ohio. He wrote this description when he was a coordinator of Discovery, the State Systemic Initiative for Ohio. Since then he has used the activity successfully with several high school classes.

Inquiring Minds Find New Challenges in Mathematics Competitions, Contests, & Events

By involving students in fun, exciting, and challenging experiences, teachers can help inspire a zeal for learning and exploration. Inject a little something different into the usual routine—try encouraging students to participate in contests and competitions.

The following mini-articles are all loosely organized around the idea of math contests, competitions, or events as a way to promote creativity in problem solving. The first article sets the stage, philosophically, for the rest. All the articles stress that the goal of participating in these activities is not to emphasize competition but to encourage students to expand their ways of thinking and reasoning mathematically.

Math Competitions to Promote Problem Solving

by Terese Herrera, ENC Instructional Resources

What could a math competition have to do with real problem solving? The ideas seem at odds with one another. How they can work together is shown in Jacqueline Pisauro's middle school classroom.

Pisauro has taught math to seventh- and eighth-graders for 22 years, and her approach is strongly grounded in inquiry teaching. She takes care to set the stage for investigation and to allow her students the thrill—and frustration—of discovery. In addition to her work as a teacher, for several years she has also coached her students in the MATHCOUNTS program, a national competition for "mathletes." (See the More About MATHCOUNTS item.)

Why Do It?

"The key purpose is not the competition itself," explains Pisauro. "The competition provides a focus, something to aim for—it motivates students to grapple with the problems." She has found that wrestling with the problem sets helps students develop overall skills in problem solving and new interest in mathematics. Her face glows as she speaks of her students' satisfaction in discovering: "There's a natural 'high' involved in working problems out—arguing, debating, finally figuring it out for themselves—a joy that is experienced at that moment when they suddenly understand concepts and relationships they've never understood before."

And How Does It Work?

Each MATHCOUNTS coach works in his or her own way, but what Pisauro does is invite all students to an after-school math club. At times, she also incorporates MATHCOUNTS problems into the classroom. Her personal approach is inquiry-based. She works ahead to solve the problems herself, but then doesn't teach the students directly how to solve them; rather, she allows them to work through the problems, experimenting and testing ideas while she keeps students focused.

Pisauro has found that the MATHCOUNTS program can complement the regular curriculum, since it stresses the major strands teachers are supposed to cover as it stretches the students' ability to reason mathematically. It also develops their awareness of pattern in number theory, algebra, and geometry. As an example, she has discovered that solving a MATHCOUNTS problem involving the Pythagorean Theorem can open up an opportunity to teach that content area right then.

Teacher-to-Teacher Tips

Teachers interested in coaching students, Pisauro suggests, might benefit as she did from the MATHCOUNTS advice outlined in their manual on running a problem-solving session. From her own experience, she recommends "doing the problems yourself. It gets you involved in problem solving and helps you experience the process of discovering those patterns and what the students go through."

She suggests inviting students with a wide range of mathematical abilities, not only the top students. She has also found that being in small groups of 10 to 15 gives students the most satisfying experience; they feel a more personal connection and become a more integral part of the discussion.

Finally, whether or not the students choose to actually participate in the national competition, Pisauro explains, "It's the process of problem solving, both individually and in a group, that develops the most important skills and gives the most satisfaction."

More About MATHCOUNTS

by Terese Herrera, ENC Instructional Resources

MATHCOUNTS is a national math coaching and competition program that promotes seventh-and eighth-grade mathematics achievement through grassroots involvement in every U.S. state and territory. The program is an education partnership involving volunteers, educators, industry sponsors and more than 350,000 students per year. Nearly 7000 schools register to participate annually.

The program has received two White House citations as an outstanding private sector initiative. National sponsors are CNA Insurance Group, the National Society of Professional Engineers, The Dow Chemical Company Foundation, General Motors Foundation, Phillips Petroleum Company, Texas Instruments Incorporated, 3M Foundation, the National Council of Teachers of Mathematics, and the National Aeronautics and Space Administration.

Beginning each fall, thousands of teachers, MATHCOUNTS alumni, and other volunteers coach student "mathletes" using the free MATHCOUNTS School Handbook. After several months of coaching, registered schools select four students to

compete as teams and individuals in one of 500 local competitions. The top teams then progress to state competitions, where the top four individuals advance to the national finals in Washington, DC.

The registration deadline for MATHCOUNTS is in mid-November. To register, complete the registration form included in the free School Kit or print the registration form on the MATHCOUNTS Web site and send it—along with a check, money order, or purchase order in the amount of $50—to:

MATHCOUNTS Registration
PO Box 441
Annapolis Junction, MD 20701
Telephone: (301) 498-6141
E-mail: math@pmds.com
http://mathcounts.org/

World's Largest Math Event

by Judith Spicer, ENC Instructional Resources

The National Council of Teachers of Mathematics (NCTM) sponsors the World's Largest Math Event (WLME) annually on a day at the end of April, which is Mathematics Education Month. On the designated day, students all over the world work together creatively to solve problems that analyze the world around them. The participants use theme-based activities found in a booklet published by NCTM each year.

The WLME is noncompetitive and is designed to include as many teachers and students as possible in activities that strive to heighten math awareness, enthusiasm, and motivation. Begun in 1995 for the celebration of NCTM's 75th anniversary, WLME has grown into an annual event with participation estimated at nearly one million students of all grades. Themes have included the Olympics and the use of mathematics in space exploration; the theme for 1999 focused on activities to help students understand the natural forces that shape our planet. The activities are designed to show students the beauty and utility of mathematics in their world.

The WLME booklet is mailed to NCTM members each February and is posted on the NCTM Web site http://www.nctm.org/. It is also available through NCTM's Fax on Demand service, (800) 220-8483, documents #215 (booklet) and #216 (supplemental activities). Teachers are encouraged to make photocopies of the activities to share with their colleagues.

International Mathematical Olympiad

by Leah Poynter, ENC Publishing

Each year a group of six high school students, selected through national math competitions, represents the United States at the International Mathematical Olympiad (IMO). Students who win a spot on the USA team participate in a challenging two-day competition that requires them to compete with students from other countries in solving advanced mathematical problems. In addition to high-level mathematics knowledge, success at the IMO requires creative problem-solving skills.

American students are selected for the IMO by participating in a sequence of three exams. The first step is the American High School Mathematics Examination (AHSME), which is taken by approximately 350,000 students each year. Roughly 17,000 of the top-scoring students advance to take the American Invitational Mathematics Examination (AIME). From this group, some 160 students go on to participate in the USA Mathematical Olympiad (USAMO).

Like the IMO, the USAMO is a series of essays and mathematical proofs that require extensive math knowledge and inventive reasoning skills. All problems can be solved with precalculus methods. The top six scorers make up the American team at the international competition.

In 1998, Melanie Wood, a student from Park Tudor High School in Indianapolis, was the first female to win a spot on the USAMO team. With her teammates, Wood competed against teams from 76 other countries at the International Mathematics Olympiad in Taipei, Taiwan. The United States tied with Hungary for third place in the Taiwan competition. Iran came in first place and Bulgaria was second.

The first IMO was held in 1959 in Romania, with only six countries participating. Over the years, it has expanded to include approximately 80 countries that take turns hosting the event. The United States began participating in the competition in 1974.

Visit http://west.camel.math.ca/IMO/ for additional information about the International Mathematical Olympiad. For more information about the USA Mathematical Olympiad and how to compete for the American team at IMO, visit http://www.unl.edu/amc/usamo.htm.

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The One-Hundredth Day of School Celebration

by Judith Spicer, ENC Instructional Resources

The One-Hundredth Day of School Celebration, held in February, is a math event rich with good ideas for developing the number sense of primary grade children. It can be viewed as the culmination of the daily calendar activity that begins on the first day of school.

Where did this idea come from? Credit is given to Lynn Taylor, who introduced the celebration of 100 days in kindergarten in the 1981-82 newsletter of the Center for Innovation in Education. The celebration has generated hundreds of creative ways for young children to work with large numbers in cross-curricular activities. There are activities for using children's literature, the Internet, and everyday objects to explore numbers, counting, and grouping.

Ideas for celebrating the day include low-tech, hands-on activities such as creating collections of 100 like items that can be used in counting and grouping activities, constructing a building with 100 paper cups, and using 100 connected paper clips to measure objects and distances. High-tech activities include collecting 100 e-mails from across the country and using calculators to skip count to 100.

Why stop at 100? What child would not like to see a pile of 1,000 pennies or paper clips or know how far 1,000 feet is? Once a class has things grouped in sets of 100, there is no limit to what large numbers can be explored.

One resource for celebrating this day is the children's literature book *Miss Bindergarten Celebrates the 100th Day* by Joseph Slate (ENC-022426). It is an alphabet picture book that describes a kindergarten class of colorful animals as they prepare for the celebration of the one-hundredth day of school. Each student animal contributes a unique collection of 100 objects, such as popsicle sticks, paper-chain links, stickers, and a special "100-day punch" with 100 cherries. The rhymed text and colorful, detailed illustrations move the celebration along with opportunities for counting, number and animal recognition, and reciting the alphabet.

For more information, check out The 100th Day of School home page http://www.siec.k12.in.us/~west/proj/100th for Internet and e-mail activities, links to other Web sites, and numerous classroom ideas for making the day exciting. Examples of cross-curricular activities for celebrating the 100th day include writing and sharing about four topics:-100 miles, 100 dollars, 100 pounds, and 100 years. In a physical education class, students can count as they do 10 sets of 10: sit-ups, touching their toes, then the shoulders, the waist, etc., and jumping jacks. Songs and books are suggested that can be used to enrich the 100th Day.

WALTER WICK'S

Choosing enticing materials, such as the books created by Walter Wick, is an important part of setting the stage for classroom inquiry and problem solving. See the accompanying article for tips on selecting books for your students.

by Annette Thorson, ENC Publishing

Walter Wick's photos have been used on the covers of more than 300 books and magazines, including *Newsweek*, *Discover*, and *Psychology Today*. Among the many admirers of Wick's work is the National Science Teachers Association (NSTA), which named his book *A Drop of Water: A Book of Science and Wonder* the Committee's Choice Book, the top honor of all the books on NSTA's annual list of Outstanding Trade Books for Children.

The committee felt that Wick had approached the work as a scientist, and their description of the book reveals why:

> Easy-to-read text and exquisite photographs explain the concepts of evaporation, condensation, capillary attraction, and surface tension. The camera halts and magnifies the action so that all states of water can be observed. A collection of simple, exceptional experiments offers ways to further investigate the principles of water transformation.

Honors for *A Drop of Water : A Book of Science and Wonder*
Written and Illustrated by Walter Wick

American Library Association Notable Children's Book
Booklist Editors' Choice
Boston Globe/Horn Book Award for Nonfiction
Bulletin of the Center for Children's Books Blue Ribbon Book
Horn Book Fanfare Book
National Council of Teachers of English *Orbis Pictus* Honor Book for Outstanding Nonfiction
National Science Teachers Association Committee's Choice Book

Book List *All books are published by Scholastic.*
Written and Illustrated by Walter Wick:

Walter Wick's Optical Tricks, 1998
A Drop of Water: A Book of Science and Wonder, 1997 (ENC # 010721)

Written by Jean Marzollo; illustrated by Walter Wick:
I Spy Gold Challenger, 1998
I Spy Little Wheels, 1998*
I Spy Little Animals, 1998*
I Spy Super Challenger, 1997
I Spy Little Book, 1997*
I Spy Spooky Night, 1996
I Spy School Days, 1995
I Spy Fantasy, 1994
I Spy Fun House, 1993
I Spy Mystery, 1993
I Spy Christmas, 1992
I Spy; A Book of Picture Riddles, 1992
*Board Books

Despite such recognition from NSTA and other authorities in children's literature (see box), Wick emphasizes his work has never had a more appreciative audience than the children themselves. Wick's understanding of his young readers qualifies him as an educator, as is clearly shown by his insightful descriptions of his interactions with them.

He loves to share a letter from a kindergarten class. On a large sheet of lined paper, the children composed a list of hypotheses on how he had taken a photo in which objects appear to float. Their first guess was that he must have worked in zero gravity so perhaps he had taken the photo while riding in the Space Shuttle. (In actuality, Wick had painstakingly glued the objects to a piece of Plexiglas to give them a floating appearance for the photo.)

The joy teachers find in classroom breakthroughs is apparent in Wick's description of one of his many school visits. One child had obviously studied the photos in his I Spy series of books with attention to the smallest detail. The student gave an animated explanation of a photo in which a series of dominoes begins a chain reaction that topples larger and larger objects. Such an enthusiastic response to one of his books is not unusual; what made it special for Wick was the comment from the classroom teacher. Wick remembers, "She said she was amazed. That particular child had never spoken in class before."

Children's and teachers' appreciation of Wick's work is likely to continue. His latest book, *Walter Wick's Optical Tricks*, blends the playful visual games of *I Spy* with the solid base in inquiry found in *A Drop of Water*. It is this combination that has earned Wick the right to be called a scientist and an educator as well as a gifted photographer. ●

Selecting Books? NSTA Provides Guidance

Using book award lists such as those provided by the American Library Association, the National Council of Teachers of English, the National Science Teachers Association, the Children's Book Council, and other respected groups is an excellent way for classroom teachers to select books for their students. However, since not every good book receives such an honor, teachers also need to develop the expertise to evaluate books themselves.

One strategy is to look at books through the eyes of the experts by applying the selection criteria they use. Along with their annual list of Outstanding Trade Books for Children, NSTA publishes information about the selection process used by their book review panel, which consists of NSTA and Children's Books Council experts. Although the summary supplied here is specific for science books, teachers can apply many of the points to books in other subject areas.

NSTA Book Selection Criteria

Content:

- The book has substantial science content.
- Information is clear, accurate, and up to date.
- Theories and facts are clearly distinguished.
- Facts are not simplified so much that the content is misleading.
- Generalizations are supported by facts, and significant facts are not omitted.
- The book is free of gender, ethnic, and socioeconomic bias.
- Presentation is logical, and sequence of ideas is clear.
- The content level is appropriate for the intended audience.

Illustrations and format:

- Illustrations enhance the presentation.
- Items shown are accurate in size, color, and scale.
- Illustration labels are clear.
- Illustrations showing people portray cultural diversity and gender equity.
- The size, format, and typeface of the book are appropriate to the subject and audience.
- Layout is well organized and advances the text.
- The paper, binding, and reproduction are of high quality.

Subject-specific criteria:

- Nature books offer the natural history and life cycles of organisms.
- Experiments suggested for children lead to an understanding of basic principles and are safe, feasible, and appropriate for the intended age level.
- Science books for children (particularly picture books with minimal text) are free of personification, teleology, or animism.
- Science books may contain stories, folktales, and poetry based on nature, but a book should stand on its own as a science book without them.
- Biographies convey the full sense of the person's character although the books might seek to inspire as well as convey the facts of the person's accomplishments.

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Note: NSTA's annual list of Outstanding Trade Books for Children is published each year in the March issue of *Science and Children*. See this publication on the NSTA Web site at http://nsta.org/pubs/sc/

20 Ways to [illegible] in Your Students

During her student teaching experience, this new teacher concentrated on making her classroom a place that encourages the diverse thinking needed for inquiry and problem solving. She is currently applying these ideas in her first year of teaching.

By Laura C. Mohr, High School Science Teacher, St. Louis, Missouri

I wrote this list to exemplify an ideal that I have been striving for but have not yet achieved. Perhaps some of these suggestions will get you started on creating your own list of ways to foster creativity in your students.

1. Free your classroom of restraints based on time, material, and tasks.
Provide several media for class projects including art supplies such as clay and paint. Give options that address the same content but in different ways.

2. Model creativity.
A creative person is independent, takes risks, and is not afraid to make mistakes. If students see you make a mistake, admit it and show rather than tell how you use it as a learning opportunity.

3. Encourage and reward creative ideas.
Shower attention on students who pursue their creative ideas. And be sure not to penalize students for coloring out of the lines or making their pumpkin purple instead of orange. Accept ideas that are outside the norm.

4. Withhold criticism while students are working on a project.
Encourage students to evaluate their own ideas and solutions by posing questions to help them focus on an area of difficulty. For example, if a student is making a poster with tiny letters, you might ask, "How far away can the viewer read that?"

5. Choose activities that are appropriate and interesting.
Use state and national education standards, such as the National Research Council's National Science Education Standards, to help you select activities for the age level of your students. To capture student interest, choose local, personally relevant issues, such as local pollution or issues before the local government.

6. Choose activities in which students must examine and relate to their surroundings.
Help students learn to make scientific observations of things in the room or immediately outside the school.

7. Encourage questions and new ideas.
Model asking questions that are open-ended, such as "Let's make a list of different sources of light." Help students learn to phrase their own questions in an open-ended manner.

8. Accept ideas that look at problems from different angles.
Turn the focus away from labeling responses right or wrong. If students find a solution that works, accept it even if it's not the way you think is best.

9. Set up a classroom environment that stimulates the senses.
Plants, animals, posters, and student work enhance learning for students on all grade levels.

10. Use problem-based and inquiry-based activities, especially problems with multiple solutions.
For example, use earth and water to investigate what can be done to prevent flooding. Ask, "How do you make a spool roll using only a rubber band and a paperclip?"

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11. Ask students to make predictions.
Encourage if-then thinking. For example, when a student predicts that dirt will settle to the bottom of a lake, ask, "If that is true, then what will happen in a river with a fast current?"

12. Ask students to elaborate on their ideas.
Stretch their thinking by asking, "What evidence do you have to support that? What do you mean by ____?"

13. Empathize with the perspectives of others.
Take all feelings into account. Don't discount different perspectives as ill informed or irrelevant. Help students who disagree to find common ground.

14. Brainstorm both as a class and in small groups.
For maximum flexibility, begin a brainstorming session using one word, for example, bird. Put that word on the overhead and ask students what they think of when they hear that word. After you find out what they know about birds, then you can address their misconceptions and introduce new ideas. In small groups, ask students to begin a problem-solving activity by brainstorming issues to address when solving the problem or different ways to solve it.

15. Make concept maps with interconnecting relationship systems.
Ask students to make as many connections as possible. Ask them to think of phrases to label the lines that connect each concept. (See a middle school student's concept map on this page.)

16. Use wait time I and II.
Practice this pattern until it becomes natural:
Teacher asks, "What would happen if there were no sun?"
(Wait time I)
Student replies, "The flowers would die."
The teacher then employs wait time II to give the student(s) a chance to elaborate.

17. Give more options for student presentations.
Singing, dancing, drawing, writing a poem, or selling their findings are all valid ways to communicate. Have students evaluate their own performance and the performance of others using specific criteria. This fosters accountability and self-reflection.

18. Guard against an over emphasis on correctness and perfectionism.
Logic doesn't solve everything, and there is always more than one answer or solution to any problem.

19. Listen to and acknowledge student ideas.
Focus your attention on student speakers, looking them directly in the eye when they talk. Try to ensure that everyone has a chance to speak. Acknowledge all contributions, without showing bias toward answers that you feel are the best.

20. Provide the medium or context, not just material to be memorized.
If you are studying the human body, for example, have students address questions they have, such as "How did my uncle get cancer?" While students investigate their own questions, your job is to provide them with activities that address the main concepts of the topic and/or the misconceptions they have revealed. Don't require students to memorize the cranial nerves unless that serves some purpose other than to say they know it. ●

Suggested Readings

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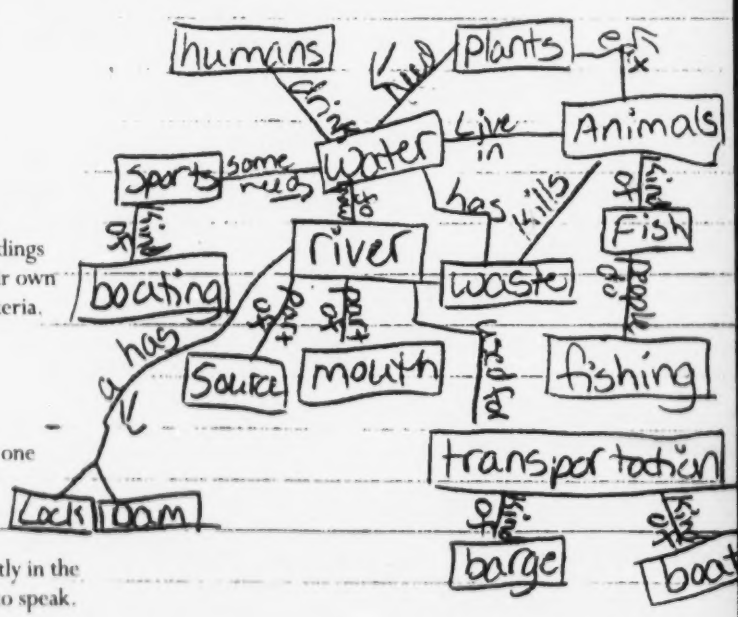
A graduate of the University of Iowa, Laura Mohr teaches chemistry, general science, and physics at Eskridge High School, St. Louis, Missouri. She completed her student teaching with Phillip Hund at Williams Intermediate School in Davenport, Iowa. She welcomes e-mail at lmohrlmohr@yahoo.com

Concept map created by a student



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Teaching from the Heart

By Kevin Cheng, The Bronx High School of Science, Class of '99

"Nothing great in this world has been accomplished without passion."
G.W.F. Hegel

It was the passion of Thomas Edison that made him give up sleep to work on his light bulb; the passion of Jonas Salk pushed him to discover the polio vaccine. It is also the passion of teachers that inspires students to open their minds. Unfortunately, not every teacher in this world is passionate in his or her teaching. I've been lucky enough to come across a few. One who helped me to succeed was Ms. Engel, the mathematics teacher I had my freshman year of high school.

I remember Ms. Engel as a kind and caring teacher filled with passion for her subject. She introduced her innovative Students Questioning Students (SQS) method to my class. SQS changed the orthodox teacher-centered classroom to a student-centered classroom. We, the students, originated the questions and helped each other to arrive at the answers. But we didn't just find the answer; we explored every nook and cranny of the problem. It got my mind ticking and made me more sociable.

I had never been fond of mathematics, but Ms. Engel made me like it. I believe that a student who learns from a teacher with no passion for his or her field might as well learn alone in a room with a textbook.

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"Students Questioning Students" Leads to Better Learning

A veteran mathematics teacher and three of her former students describe how Socratic questioning improves communication, builds interpersonal skills, and increases depth of understanding.

by Judith Engel, Director, SQS WORLDWIDE

I was 24 years old. After three years of teaching in a vocational school and a junior high school, I started the rest of my 40 years of teaching mathematics at The Bronx High School of Science in New York City.

I did not know then that, 25 years later, one approach I would use in that first year teaching geometry would become known as Students Questioning Students (SQS). This technique has not only received grants and awards for innovation in teaching, but was also featured on the program, "Teaching Children to Think," shown on national television on the American Federation of Teachers series, *Inside Your Schools*, with Steve Allen as host.

Early on as a teacher, I believed that students should be active, thinking participants in the classroom and not vessels into which mathematics is poured in teacher-talk lessons. It seemed logical to me that in presenting proofs in geometry, students could question their peers about reasons for their statements in a proof.

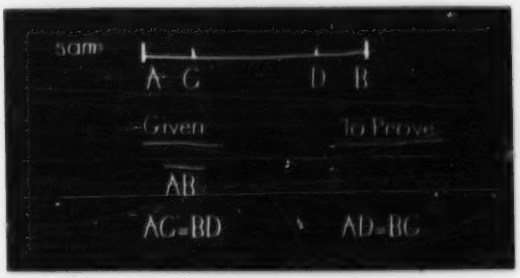
The simple example in the box below illustrates some components that are very important in SQS. One is the concept of speaking in complete English sentences, a habit that is so important that my students and I refer to it with an acronym, CES. In addition to reading the problem as a CES, notice that Jack answers Sam's question in a CES, and that he repeats the chief words of Sam's question. By doing so, the respondent brings about continuity of thought, and, if a student does not hear the question posed, he/she will learn something from the CES answers. Students report that use of CESs and the repetition of questions enhance the degree of retention of material.

An equally important key to SQS is courtesy and respect for every person every day. No one ever laughs when a mistake is made, and sometimes the class applauds a truly spectacular presentation. Another example of respect for the group is Jack's use of "we" instead of "I" when he explains a concept. Students' referring to each other by name is a courtesy that also enhances sociability.

A Simple Example

Let's see how a very simple geometry proof might sound as an SQS presentation.

Student volunteer Sam writes the problem on the chalkboard and puts his name above his work:



As the presenting student, Sam knows he needs to start by calling on a fellow student: *Please read the problem, Jessica.*

Jessica then reads the "given" and the "to prove" parts of the problem.

Sam: *Thank you, Jessica.*

Sam proceeds to prove AD = BC, which he reads as a "complete English sentence": *The length of segment AD equals the length of segment BC.*

Sam: *We know that segment AC is equal to segment BD because it is given. It's the hypothesis. But why is CD equal to CD?*

He allows think time, then calls on volunteer Caryn.

Caryn: *CD equals CD because any number is equal to itself.*

Sam: *Thank you, Caryn. How can we explain that AD equals BC?*

He allows think time, then calls on Jack, a non-volunteer.

Jack: *We can explain that AD equals BC because "If equals are added to equals, then their sums are equal."*

Jack takes the initiative (a big component in SQS) to go to the chalkboard to point out three sets of equals to all of us.

Sam gives appreciative praise to Jack: *I liked your clear answer, Jack, and you used the words of the question.*

Sam completes his presentation by introducing the next homework presenter by name: *Isabelle.*

Another important skill is to learn to give appreciative, rather than judgmental, praise to their peers. Contrast Sam's response to Jack in the example dialog with judgmental praise: "Your answer was excellent."

Other communication skills are developed in the SQS program. Students are encouraged to speak loudly and enthusiastically. The seats are arranged in semicircles so students always face the speaker. They listen attentively to each other so that they can enter into a mathematical discussion and use their mathematical vocabulary. Virtually every student is called on every day, and students know they are obliged to participate to make every lesson a successful and fun learning/teaching experience for all.

Expanding on the Idea

After some years, I introduced SQS in my algebra and in my trigonometry classes. I was not surprised when it worked there, too. SQS can be used in any subject area, at any age or grade level, with any kind of student. My students have tutored their friends and their younger siblings using SQS. They consistently tell me that this approach should be introduced in the lower grades. As one student states, "All subjects involve things that can be discussed and analyzed."

I believe that children are born to question, but their curiosity is often stifled by teachers and other adults in their lives. I also believe that children can learn Socratic questioning of each other on a high level that promotes analysis and synthesis of material.

Children can become expert questioners, often asking questions and seeing connections between aspects of the lesson that we adult teachers have never thought about. It is very exciting to be an SQS teacher because you are being enlightened during every lesson.

To make the change, we need to ask ourselves if we trust our students. Do we believe that sometimes our students' presentations can surpass our own in educational value? Do we give our students responsibility? They love to have jobs in the classroom! Do we assist our students in developing their leadership potential? Students like to be chairpersons, assigning their peers to put the homework problems on the chalkboard and then leading the discussions of those problems.

Critical to the success of an SQS classroom is the teacher's relinquishing control of and responsibility for each student's educational accomplishment. Once the teacher does that, students develop self-confidence as risk takers and as independent SQS learners/teachers. When students question students to construct their own knowledge, they develop lifelong social interactive skills and caring attitudes toward their classmates, and their teacher, too. There is a team effort. Cooperation increases; competition decreases. ●

For more information about the SQS program, which includes material and workshops, contact: Judith Engel, Director, SQS WORLDWIDE, PO Box 242, Bronx, NY 10466-0300

True Knowledge Comes from Within

By Max Lipyanskiy, The Bronx High School of Science, Class of '99

During my first year of high school, I had the good fortune of learning mathematics in Judith Engel's innovative class. Her creative approach, Students Questioning students (SQS), involved the implementation of Socratic questioning in a student-centered environment. When a new problem was introduced, the class had to figure out the solution either independently or as a team, but always without a lecture-type explanation from the teacher.

After adjusting to this method, I learned to approach each problem from a critical perspective. I discovered that true knowledge comes from within, and all one needs is stimulation. It soon became evident that the best way to learn was by discovering the knowledge yourself. In time, through help from my peers, I learned how to focus, develop, implement, advance, adapt, and always question.

I also came to believe that true learning includes not only the course curriculum, but also the social interaction that comes with it. In Ms. Engel's classroom, the class taught/learned as a team. When I came to the class as a shy freshman, I could hardly voice my opinion. With the passing months, my confidence grew, and I realized that my ideas were important. While working in groups with my classmates, I learned to express my views and listen to others. In the spring semester, I knew that somehow I was not the same person who had walked into that math class in September. I knew that in those few months I had gained skills to be used for the rest of my life.

Caring + Initiative = Success

By Jorge Ortiz, The Bronx High School of Science, Class of '99

I entered the Bronx High School of Science unsure of what I really wanted to do with my life. As I walked down the hallway for third period math class, I worried that my "freshmanism" showed. It did. I had trouble finding the room and arrived late and sweating from my anxiety. That's when I entered the room where I would find my true love for mathematics.

The first thing I noticed was the teacher, Ms. Engel. She was as flamboyant a teacher as I had ever seen. She began by telling us that to succeed in her class, we first needed to care for ourselves, for each other, and for the work. Then she said that caring is shown with initiative. I had never heard a teacher say this. I could tell that she really wanted us to learn in her class and not to be intimidated by one another.

Soon, I became very comfortable in the class. The students taught and helped each other. Everyone was equal. I learned to admire this Socratic method of teaching, and it helped me in all future classes.

I have been very successful in high school. I completed a Westinghouse project on chaos and fractals. My senior year, I took AP Physics C (with calculus), AP Computer Programming in C++, AP Calculus, AP Latin, and AP psychology. I plan on majoring in Astrophysics and Computer Science in college.

I learned more than just academics from Ms. Engel. I learned that you have to care about what you do, and that to get anywhere in this world, you have to take the initiative because nobody is going to do it for you.

The ENC Collection: Classroom Resources for Inquiry and Problem Solving

By Terese Herrera and Kimberly S. Roempler, ENC Instructional Resources

In the science classroom, inquiry can mean third graders proposing questions on amphibians, then grouping around a table to observe a live chameleon and make notes on what they see. Or inquiry can mean a physics class running toy cars on increasingly steeper ramps, plotting angles and times on a graph (as in Heinmiller's lesson, p. 30).

In the math classroom, inquiry can mean fifth graders designing a statistical study on the average amount of time commercials take during a one-hour broadcast. Or it can mean geometry students looking for a pattern in the areas of the squares on the sides of right-angled triangles.

As we selected instructional materials for this issue of *ENC Focus*, we looked for inquiry-based resources that would draw students into investigation—work that would involve them with real questions to stretch their critical thinking, and perhaps even to discover for themselves some of the relationships that abound in mathematics and science.

Such inquiry and problem-solving activities can:

- help students see connections between classroom learning and the world outside the classroom;
- motivate them to use the skills already learned and to see the need for new skills; and
- engage them in constructing meaningful concepts and, eventually, generalizations.

That "problem solving should be the central focus of the mathematics curriculum" is a basic tenet of the National Council of Teachers of Mathematics (NCTM) standards: "Problem solving is not a distinct topic but a process that should permeate the entire program and provide the context in which concepts and skills can be learned" (NCTM, 1989). Similarly, the National Science Education Standards (NSES) state that inquiry into authentic questions generated from student experiences is the central strategy for teaching science (NSES, 1996) and that engaging students in inquiry helps them develop understanding of scientific concepts. It can also instill in students an appreciation of "how we know what we know" in science.

Professional Development

We were also interested in resources that addressed the why and how of implementing inquiry and problem solving. The bottom line is this: there is a limited amount of school time, and yet there are seemingly endless demands on it. And in math and science classrooms, pressure today is on learning facts, honing skills, and memorizing definitions. While Ron Anderson, teacher educator and researcher at the University of Colorado, notes that inquiry "is the favored word for describing the essence of good science teaching" (p. 16), the word when applied to mathematics teaching is more difficult to interpret, and time dedicated to the inquiry process—observing, explaining the observations, and arriving at a generalization—can be difficult to justify in both the math and science classrooms.

Yet there are teachers in both subjects who are certain that time spent in inquiry teaching results in engaged student learning. What are their reasons? And how do they do it? The Professional Development portion of this section addresses these issues.

Instructional Resources

We realized that to incorporate inquiry and problem solving into the curriculum, teachers need worthwhile activities: problem scenarios dealing with substantive subject matter, embedded in a context understood by the student, and sufficiently challenging to hold student interest and demand critical thinking. You will find a sampler of such activities under the heading Instructional Resources. These are complete teaching modules or projects that focus on one topic, but they also allow the topic to naturally expand to related content.

For example, in *Right Angle* (ENC-013834), one of the Jasper Woodbury videodisc series, middle school students use their knowledge of angles and learn elements of topography and orientation skills to locate a missing person and direct the rescue squad to the location. The Realization Technology series, developed for upper elementary and middle school students, contains open-ended technology puzzles that help students develop their general problem-solving skills, measurement skills, and logical thinking. One item from the series, *The Cat on the Chimney* (ENC-013420), engages students in designing a rescue device to get a frightened cat down from a chimney. Big books provide the scenario and describe tools students can use to solve the problem.

Construction Materials

The construction sets highlighted in this issue allow for the development of spatial thinking and increase creativity. They also serve as concrete models from which to learn principles of physics and other disciplines.

For example, the LINX System (ENC-013514), developed for elementary and middle school students, contains materials and instructions for open-ended, wood-based building and construction projects. Students begin by constructing a simple, balloon-powered land yacht. Then they expand their building to challenges such as designing and constructing a rubber-band powered vehicle that will travel at least three meters.

The K'NEX Roller Coaster Kit (ENC-012237) asks students to build ramps, spirals, and loops while learning about roller coaster physics, deriving formulas through experimentation. Inquiry exercises engage students in making predictions about the behavior of the roller coaster, ball loop, or inclined planes based on their understanding of physics. Students then test those predictions and revise their theories as necessary.

Sources of Good Problems

In addition to teaching units and manipulatives, mathematics teachers look for individual problems that students might find worth investigating. These can be of the Problem-of-the-Week (POW) variety or even games that require logical thinking and that can lead to discussion of the "Big Ideas" encountered.

In this group, we have included several Internet sites that offer problem situations, among them the Problem-of-the-Week Homepage (ENC-013752) with links to POW problems on several sites. Other resources come in software formats, such as *Factory Deluxe* (ENC-011765), a strategy game that engages students in transformations and requires spatial thinking as they shape a product and then package it for shipping.

More traditional book presentations include *Super Problems* (ENC-011447), which uses a three-pronged approach: a warm-up problem to learn the needed strategies, the central problem of the set, and a final extension problem for topics that offer more challenge. For the school that wants to promote problem solving among all its students, *Sunshine Math: Superstars* (ENC-013559) offers a voluntary program in which K-8 students work on a page of problems per week to earn stars and recognition.

Technology Tools for Exploration

When setting off to investigate a real problem, teachers as well as students now have access to technological tools that allow them to collect and analyze data more efficiently. Students, able to see real time graphing of data as they collect it, can predict or estimate and then compare the actual results with their predictions.

For example, the PASCO microcomputer-based laboratory interface system (ENC-010956) allows students to collect and analyze data with a variety of sensors including light, motion, and sound. Other tools featured in this section enable students to explore mathematical constructs in geometry (*Geometric SuperSupposer*, ENC-013545) or algebra (*Explorations in Algebra*, ENC-007049) via graphing calculators and software.

Competitions

Finally, math competitions and science fairs provide an exciting opportunity for students to flex their creative problem-solving muscles and develop new skills at the same time. Ideas presented in this group range from entry into an online Student Stock Tournament (ENC-011859) to MATHCOUNTS (ENC-012556), an annual national math contest for middle school students. (For more information on math competitions and events, see page 32.)

Another example of a resource in this group is Science Fairs, Ideas and Activities (ENC-013181), a book that contains a variety of ideas for planning successful science clubs and fairs. We have also listed a variety of Web sites that provide science fair ideas and a virtual science fair.

All the resources featured in this issue were selected from ENC's existing collection and, due to limited space, represent only a fraction of the materials in that collection. Many new materials are added to the collection daily, so be sure to search our online catalog, ResourceFinder http://www.enc.org/rf/index.htm, to find those best suited to your grade level and curriculum.

Please let us know of other materials you recommend via e-mail at submit@enc.org. We will do everything possible to include them in our collection. Our aim at ENC in highlighting these exemplary resources is to give educators, in the classroom or in the home, ideas that will help in their ongoing efforts to bring inquiry-based activities to their students.

References

National Council of Teachers of Mathematics. (1989). *Curriculum and Evaluation Standards for School Mathematics.* Reston, VA: Author.

National Research Council. (1996). *National Science Education Standards.* Washington, DC: National Academy Press.

The very easiest way to access all the Web sites mentioned in this magazine is to visit the online version:

http://www.enc.org/focus/

SEARCHING

ENC's Collection of Curriculum Resources

You can get to *Resource Finder*, ENC's online database of educational materials, at http://www.enc.org/. Four search engines are available to search ENC's collection of math and science resources: the Simple Search and three advanced search options (No Frames Enhanced, Enhanced Search, and Browse/Search). A site search is available that searches the entire ENC Online Web site.

Simple Search allows you to search using words as well as grade level and cost. A sample Simple Search could include Hands-on AND Butterflies as Search Words, Grade 2, and any cost. The return list includes resources with both "hands-on" and "butterflies" in the catalog records.

The No Frames Enhanced search allows you to better limit and define your search. In addition to word search, grade level, and cost, limiters such as Resource Type, Subject, and Standards are available. Lists of ENC's controlled vocabulary are provided. For instance, Resource Type includes words such as Math Curriculum Programs, Professional Guides, Teacher Guides, and World Wide Web (WWW) resource. A sample search using No Frames Enhanced could have Algebra (if you use more than one subject, the terms needs to be separated by a comma) as Subject; 6 as Grade; and Math Curriculum Programs as Resource Type. One of the resources in the return list is Sixth Grade Everyday Mathematics Teacher's Resource Package (ENC-012104). The Enhanced Search, which uses frames, features pop-up vocabulary lists. The Browse/Search feature allows you to browse large categories based on ENC's subject lists.

You can also search by ENC number, a designation we assign to each resource to indicate where it is shelved in our repository. The number can be found in the upper left of the catalog record on your computer, or at the end of the abstract in *Focus*. You can search for specific records in Resource Finder by typing in the ENC number in the search words blank. For example, typing in ENC-012795 brings up the record for *There Is No Away* (1997), published by Kendall/Hunt (see page 42). When contacting ENC about a particular resource, be sure to refer to the ENC number.

For each item in a return list, an icon lets you know what kind of resource it is (for example, video, kit, or Web site). Each icon is followed by descriptive text that contains its title, grade range, cost range, and the beginning of the abstract. Clicking on the title brings up the entire record, including the complete abstract, the table of contents, any evaluations, and availability information.

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PROFESSIONAL DEVELOPMENT

About Teaching Mathematics: A K to 8 Resource . . . . . Grades K-8 45
Mathematics with Reason: The Emergent Approach to Primary Maths . . . . . Grades Pre-K-6 45
Making Sense: Teaching and Learning Mathematics with Understanding . . . . . Grades 1-5 45
National Science Education Standards . . . . . Grades K-12 46
Curriculum and Evaluation Standards for School Mathematics . . . . . Grades K-12 46
The Open-Ended Approach: A New Proposal for Teaching Mathematics . . . . . Grades 1-12 47
How to Use Problem-Based Learning in the Classroom . . . . . Grades K-12 47
Thinking Through Mathematics:
Fostering Inquiry and Communication in Mathematics Classrooms . . . Grades 9-12 47
Strategies of Problems Solving . . . . . Grades 1-8 48
Private Universe Teacher Workshops . . . . . Grades 1-12 48
Boats, Balloons, and Classroom Video: Science Teaching As Inquiry . . . . . Grades K-6 49
Organizing Wonder: Making Inquiry Science Work in the Elementary School . . . Grades K-6 49
Teaching About Evolution and the Nature of Science . . . . . Grades K-12 49
Educational Technology: Support for Inquiry-Based Learning . . . . . Grades K-12 50
Role of Laboratory and Field Instruction in Biology Education . . . . . Grades K-12 50

INSTRUCTIONAL MATERIALS: Real Resources

Mathematics, Modeling Our World, Course 1 . . . . . Grade 9 51
The Antarctica Project: A Middle School Mathematics Unit . . . . . Grade 7 51
Here's the Scoop: Follow an Ice Cream Cone Around the World . . . . . Grades K-3 51
Against the Odds Classroom Instructional Resources . . . . . Grade 7 52
The Right Angle . . . . . Grades 5-8 52
Polynomial and Rational Functions: Building Boxes . . . . . Grades 9-12 53
Math in Science Bundle . . . . . Grades 9-12 53
Using Fractions, Decimals, and Percent . . . . . Grades 5, 6 53
Fraction Circles . . . . . Grades 2-9 54
Tabletop Jr. . . . . Grades 3-6 54
Algebra in a Technological World . . . . . Grades 9-12 54
Sunshine Math, Superstars III: Saturn 5 . . . . . Grade 5 55
Science Detectives . . . . . Grades 3, 4 55
The Cat on the Chimney: Solving Problems with Technology . . . . . Grades 4-7 56
Alone in the Desert: The Science of Survival . . . . . Grades 5-8 56
Motion: Activities & Reader . . . . . Grades 11, 12 57
Conservation Laws & Concept-Based Problem Solving: Activities & Reader . . . Grades 11, 12 57
Ultimate Science Kit . . . . . Grades 3-9 57

INSTRUCTIONAL MATERIALS: Internet Resources

Physics 98 Institute . . . . . Grades 6-12 58
Advanced Biology . . . . . Grades 11, 12 58
Carolina Coastal Science . . . . . Grades 4-12 58
Hello Dolly: A Webquest . . . . . Grade 11 and up . . . 59
Explore the GLOBE Program . . . . . Grades K-12 59
EnviroNet Monitoring Projects . . . . . Grades 5-12 59
Whelmers . . . . . Grades K-12 60
Middle School Institute for Math-Science Integration . . . . . Grades 5-8 60
Welcome to the Monarch Watch! . . . . . Grades K-8 61
Monarchs in the Classroom: An Inquiry-Based Curriculum for Grades K-2 . . . . . Grades K-2 61
Monarchs in the Classroom: An Inquiry-Based Curriculum for Middle School . . . Grades 5-8 61

INSTRUCTIONAL MATERIALS: Construction Sets

LINX System . . . . . Grades 4-8 62
Zometool Explorer Kit . . . . . Grades 1-12 62
Roller Coaster Physics . . . . . Grades 8-12 62
Early Simple Machines Set . . . . . Grades K-2 63

BEST COPY AVAILABLE

SOURCES OF GOOD PROBLEMS: Real Resources

The Factory Deluxe: Strategies in Problem Solving . . . . . Grades 4-8 63
Favorite Problems . . . . . Grades 5-7 63
Super Problems . . . . . Grades 7-9 64
Logic Algebra Problems . . . . . Grades 9-12 64
Logic Geometry Problems . . . . . Grades 9-12 64
Logic Number Problems . . . . . Grades 7-12 65
Group Solutions, Too!
More Cooperative Logic Activities for Grades K-4 Teacher's Guide . . . Grades K-4 65
Games for Number Sense . . . . . Grades 1, 2 65

SOURCES OF GOOD PROBLEMS: Internet Resources

Networking Projects . . . . . Grades 7-12 66
Set Enterprises Home Page . . . . . Grades 3-12 66
Shack's Math Problems . . . . . Grade 9 and up 66
Mathmania . . . . . Grade 4 and up 66
MathsNet . . . . . Grades 6-12 67
Problem of the Week Homepage . . . . . Grade K and up 67

TECHNOLOGY TOOLS FOR EXPLORATION

Chance Encounters: A Probability Laboratory . . . . . Grades 4-7 68
The Geometric SuperSUPPOSER . . . . . Grades 6-12 68
Explorations in Algebra for the TI-82 and the TI-83 . . . . . Grade 10 and up . . .69
Data Explorer . . . . . Grades 4-8 69
Calculator-Based Laboratory (CBL) System . . . . . Grade 7 and up . . .70
Universal Lab Interface Package . . . . . Grades 7-12 70
Introduction to Airplane Design . . . . . Grades 8-12 70
Interactive Physics Simulations . . . . . Grades 8-12 71
Visual Physics . . . . . Grades 9-12 71
Thinkin' Science . . . . . Grades 1, 2 72
Thinkin' Science Zap! . . . . . Grades 3-6 72
Velocity and Acceleration . . . . . Grades 8-12 73
The Bungee Egg Challenge . . . . . Grades 8-12 73
Living Things . . . . . Grades 4-6 73
Science Sleuths, Volume 1: The Mysteries of the Blob and
The Exploding Lawnmowers . . . . . Grades 6-12 74

COMPETITIONS: Real Resources

Mathematics Contests: A Guide for Involving Students and Schools . . . . . Grades 9-12 75
Academic Competitions for Gifted Students:
A Resource Book for Teachers and Parents . . . . . Grades K-12 75
Janice VanCleave's Guide to the Best Science Fair Projects . . . . . Grades 5-8 75
Science Fairs, Ideas and Activities . . . . . Grades 7-12 75
1998-1999 MATHCOUNTS School Handbook . . . . . Grades 7, 8 76

COMPETITIONS: Internet Resources

MATHCOUNTS . . . . . Grades 7, 8 76
Welcome to the Math League: Building Student Interest and Confidence
in Mathematics Through Solving Worthwhile Problems . . . . . Grades 4-12 77
CNBC Student Stock Tournament . . . . . Grades 4-12 77
Science Hobbyist . . . . . Grades 7-12 77
Science Talent Search . . . . . Grades 9-12 77
Virtual Science Fair . . . . . Grades K-6 78
Experimental Science Projects: An Introductory Level Guide . . . . . Grades 4-12 78
Dr. Internet . . . . . Grades 1-12 78

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Please note that this section is based on abstracts found in Resource Finder, ENC's database of K-12 materials. All ENC abstracts are descriptions rather than evaluative reviews. If you search Resource Finder through ENC Online http://www.enc.org/ you will find complete records for these selections. Some records provide links to online, third-party reviews and/or references to journal reviews. Pricing and ordering information was verified in February, 1999, and is subject to change.

Math Solutions Series

About Teaching Mathematics: A K to 8 Resource

Grades K-8
1992

Author: Marilyn Burns
Publisher: Math Solutions Publications

Ordering Information:
Cuisenaire Dale Seymour Publications
10 Bank Street
PO Box 5026
White Plains, NY 10602-5026
Fax: (914) 328-5487
Toll-free: (800) 872-1100
http://www.awl.com/dsp/

$27.95 per book
Order # EN501-036068

Standards: NCTM Curriculum and Evaluation Standards (1989)

The goal of this book is to help teachers implement mathematics instruction that develops students who feel mathematically secure, use numbers confidently to come to decisions, understand mathematical principles, and can apply their understanding to problem-solving situations. The book, written in support of the National Council of Teachers of Mathematics (NCTM) *Curriculum and Evaluation Standards* (1989), is organized into three main parts. The first part addresses basic mathematics education topics including the content of curriculum, problem solving as the focus of math teaching, how children learn, and the place of arithmetic. The second part presents a sampler of more than 200 classroom-tested problem solving activities divided into sections for the following curricular strands: measurement, probability and statistics, geometry, logic, patterns and functions, and number. Each section contains background information on the strand, a detailed outline of a sample problem solving experience for cooperative groups, and the activities. In one geometry activity, students investigate all the ways to arrange four toothpicks following a certain set of rules; after they record their shapes on paper, they play a game using the results. The third part of the book focuses on arithmetic instruction and its changing role in the curriculum. The book also contains a list of books, videos, articles, and sources for educational materials, as well as blackline masters needed for the activities. (Author/KFR) ENC-008504

Mathematics with Reason: The Emergent Approach to Primary Math

Grades Pre-K-6
1992
Author: edited by Sue Atkinson

Ordering Information:
Heinemann Educational Books, Inc.
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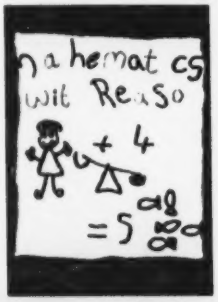
Standards: NCTM Curriculum and Evaluation Standards (1989)

Written with the NCTM standards in mind, this book explores ways of making mathematics teaching more effective both at home and at school. It is divided into three sections. The first is an introduction that considers theory. Issues covered include problem solving, standard notation, graphing, and children's intuitive methods. The second consists of several teachers' real life stories of how the theory works in classrooms. This section features helpful headings for each of its chapters that indicate situations, themes, and age group. The third looks at the practicalities of adopting the emergent approach and the different ways to move forward. It discusses topics such as teacher organization and confidence. The ideas in the text come from teaching and advisory work, from research, and from discussions with groups of teachers and parents. (Author/KFR) ENC-007763



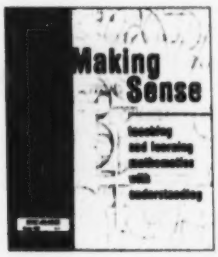
Making Sense: Teaching and Learning Mathematics with Understanding

Grades 1-5
1997
Author: James Hiebert, Thomas P. Carpenter, Elizabeth Fennema, Karen C. Fuson, Diana Wearne, Hanlie Murray, Alwyn Olivier, Piet Human; foreword by Mary M. Lindquist

Ordering Information:
Heinemann Educational Books Inc.
361 Hanover Street
Portsmouth, NH 03801-3912
Telephone: (603) 431-7894
Fax: (800) 847-0938
Toll-free: (800) 541-2086
custserv@heinemann.com
http://www.heinemann.com/

$22.50 per book (paperback)
Order # 07132-ENC

This book presents current research-based ideas on how to design classrooms that help students learn mathematics with understanding. As members of a working group of the National Center For Research in Mathematical Sciences Education at the University of Wisconsin-Madison, the authors collaborated in research on the teaching and learning of whole-number arithmetic in elementary school. The authors explain the consensus that emerged, from their work in four separate research programs, on the essential features of classrooms that support students' mathematical understanding. Extensive illustrations of how these classrooms might work are included. The authors hope to provide a framework within which teachers can reflect on their own practice and on what it means to teach for understanding. A list of references is included. (Author/JRS) ENC-011845



BEST COPY AVAILABLE

National Science Education Standards

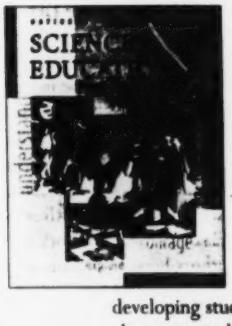
Grades K-12
Date: 1996
Author: National Research Council

Ordering Information:
National Academy Press
2101 Constitution Avenue NW
Washington, DC 20418
Telephone: (202) 334-2334
Fax: (202) 334-2793
Toll-free: (800) 624-6242
http://www.nap.edu/
Note: Full text available online at http://books.nas.edu/books/ 0309053269/html/index.html

$19.95 per book
Note: Bulk order discounts are available.

Funding: National Science Foundation; United States Department of Education; National Aeronautics and Space Administration; National Institutes of Health; National Academy of Sciences; Volvo North American Corporation; Ettinger Foundation, Inc.; Eugene McDermott Foundation

The *National Science Education Standards* present a vision of a scientifically literate populace. They are guided by the following principles: science is for all students; learning science is an active process; school science reflects the intellectual and cultural traditions that characterize the practice of contemporary science; and improving science education is part of systemic education reform. The standards describe an educational system in which all students demonstrate high levels of performance, teachers are empowered to make the decisions essential for effective learning, and supportive educational programs and systems nurture achievement. The introduction outlines goals for school science, underlying principles, perspectives and definitions, and six categories of standards. The standards cover the topics of science teaching, professional development, assessment, science content, science programs, and systems. They describe the conditions necessary to achieve the goal of scientific literacy for all students. The standards for teaching focus on what teachers know and do, while those for professional development focus on how teachers develop professional knowledge and skill. The assessment standards are criteria for judging the quality of assessment practices and can be used as guides in developing practices and policy. The standards for content define what the scientifically literate person should understand and be able to do after 13 years of schooling. These standards define content to include: inquiry; the traditional areas of physical, life, and Earth sciences; connections between science and technology; science in personal and social perspectives; the history and nature of science; and unifying concepts and processes. The content standards are supported by information on developing student understanding. They are also supported with examples and vignettes describing teaching and assessing for understanding. The program standards provide criteria for judging the quality of and conditions for school and district science programs. These standards focus on issues that relate to opportunities for students to learn and for teachers to teach science as described in the standards. The science education system standards define criteria for assessing those components of the science education system responsible for providing schools with the financial and intellectual resources necessary to achieve the national standards. Samples and vignettes are provided throughout the document. References are provided for each standard. (Author/KSR) ENC-006101



Curriculum and Evaluation Standards for School Mathematics

Grades K-12
1989
Author: prepared by the Working Groups of the Commission on Standards for School Mathematics of the National Council of Teachers of Mathematics

Ordering Information:
National Council of Teachers of Mathematics, Inc.
1906 Association Drive
Drawer A
Reston, VA 20191-1593
Telephone: (703) 620-9840
Fax: (703) 476-2970
Toll-free: (800) 235-7566
orders@nctm.org
http://www.nctm.org/
Note: Full text available online at http://www.enc.org/reform/journals/ENC2280/280dtoc1.htm

$25.00 per book (Specify English or Spanish)
Note: 20% discount to NCTM members.

This resource document contains a set of standards for developing mathematics curricula in K-12 schools and for evaluating the quality of both curricular programs and student performance. The document is designed to establish a broad framework to guide reform in school mathematics. It presents standards divided among four sections: K to 4; 5 to 8; 9 to 12; and evaluation. Each standard begins with a statement of mathematical content, followed by a description of student objectives and a detailed discussion with instructional examples. The first four curriculum standards in each section are problem solving, communication, reasoning, and connections. Specific content standards for primary, middle, and high school levels are then presented, along with a rationale for inclusion and sample activities intended to convey the spirit of the mathematical content and instruction. The evaluation section is presented separately in 14 standards organized in three categories: general assessment, student assessment, and program evaluation. (Author/VN) ENC-002280

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The Open-Ended Approach: A New Proposal for Teaching Mathematics

Grades 1-12
1997
Author: edited by Jerry P. Becker, Shigeru Shimada

Ordering Information:
National Council of Teachers of Mathematics, Inc.
1906 Association Drive
Drawer A
Reston, VA 20191-1593
Telephone: (703) 620-9840
Fax: (703) 476-2970
Toll-free: (800) 235-7566
orders@nctm.org
http://www.nctm.org/

$19.95 per book (paperback)
Order # 631-ENC

Standards: NCTM Curriculum and Evaluation Standards (1989)

Teachers and teacher educators can read this translation of Japanese essays to find research on open-ended questions and their use in the mathematics classroom. The book discusses the potential of open-ended questions for improving teaching and learning. Other sections explore the use of such questioning to assess and evaluate student higher order thinking skills. Examples of lesson plans using this approach can be found in every section. In one such example, the teacher gives students the multiplication table for the first 10 whole numbers and asks them to draw conclusions about what they see. With each example, readers will find the pedagogical context, expected responses, and teaching tips. (Author/RMK) ENC-012616

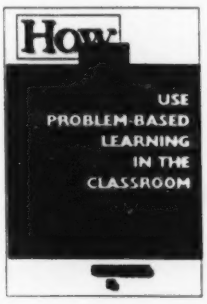
How to Use Problem-Based Learning in the Classroom

Grades K-12
1997
Author: Robert Delisle

Ordering Information:
Association for Supervision and Curriculum Development
1703 N. Beauregard Street
Alexandria, VA 22311-1714
Telephone: (703) 578-9600
Fax: (703) 575-5400
Toll-free: (800) 933-2723
member@ascd.org
http://www.ascd.org/

$10.95 per book (ASCD member price)
Order # 197166-ENC
Note: $12.95 non-member price.

Problem-based learning (PBL) is a teaching technique that educates by presenting students with a situation that leads to a problem for them to solve. Frequently, students must interpret the question and gather additional information before they create possible solutions, evaluate options to find the best solutions, and then present their conclusions. The first three chapters define PBL, provide a rationale for its use in the classroom, and clarify the role of the teacher. Subsequent chapters provide forms and checklists to help teachers formulate their own problems, direct the problem-solving process, and assess learning. The book also includes five sample PBL units for grades 3, 5, 7, 9, and 11/12. In the grade 9 unit, for example, students learn about nutrition as they design a new school lunch program. In the grade 11 project, students learn about acids and bases as they evaluate a variety of over-the-counter stomach medicines. A bibliography of suggested readings is provided. (Author/LCT) ENC-011848



Thinking Series

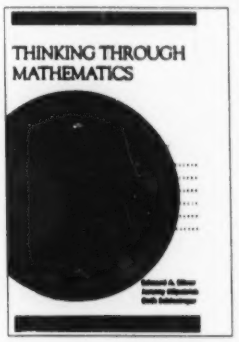
Thinking Through Mathematics: Fostering Inquiry and Communication in Mathematics Classrooms

Grades 9-12
1990
Author: Edward A. Silver, Jeremy Kilpatrick, Beth Schlesinger

Ordering Information:
College Entrance Examination Board
The College Board
Department WWW
Two College Way
Forrester Center, WV 25438
Fax: (800) 525-5562
Toll-free: (800) 323-7155
http://www.collegeboard.org/

$14.95 per book (paperback)
Note: Plus $4.00 shipping and handling.

The authors of this book propose ways that teachers can connect thinking and mathematics via a problem-solving approach. The book is part of the Thinking Series, a series of publications initiated by the College Board's Educational EQuality Project (a 10-year effort to improve the quality of secondary education and to ensure equal access to college for all students). The series is intended to address the work of teaching all students how to become competent thinkers, with the goal that thinking will become an essential objective of all classroom activities for all students in all subjects. Through discussion, cognitive research, and examples from classroom practice, the series addresses how teachers are modifying their classroom practice to encourage students to think. This book begins with an explanation of the changing perspectives on what it means to learn and do mathematics; it goes on to explore how these perspectives can be incorporated into the teaching of secondary mathematics. Working in groups or individually, teachers are invited to use the authors' examples of problems or tasks as models to help them find, construct, and invent their own activities and problem situations. Sample problems in the book are drawn from newspaper stories, everyday experience, and adapted from textbooks. Vignettes of actual teachers' experiences are used to illustrate how teachers can modify their practice to incorporate thinking activities. Considerable emphasis is placed on changing the nature of discourse in the classroom, including providing students with opportunities to make conjectures and to reflect on, refine, discuss, and amend their conjectures. (Author/GMM) ENC-007428



Day with Lola May Series

Strategies of Problems Solving

Grades 1-8
1992
Author: Lola J. May
Publisher: Moving Picture Company, Inc.

Ordering Information:
Cuisenaire Dale Seymour Publications
10 Bank Street
PO Box 5026
White Plains, NY 10602-5026
Fax: (914) 328-5487
Toll-free: (800) 872-1100
http://www.awl.com/dsp/

$26.75 per video
Order # EN501-JS22245

$3.50 per teacher's guide
Order # EN501-JS22330

In this 20-minute video, part of a series of 15 inservice videos for mathematics teachers, American mathematics educator Lola J. May offers advice and suggestions for teaching various topics in elementary mathematics. May suggests using number puzzles as a preliminary activity in teaching problem solving. She discusses group problem solving and problem-solving strategies such as backward strategy, drawing a diagram, acting it out, and making a table. She also talks about problem solving with geometric shapes. (AM) ENC-001412

$295.00 per series
Note: The series includes 10 videos and 1 workshop guide.

$25.00 per workshop guide

$39.95 per video

Funding: Annenberg/CPB Math and Science Project.

Private Universe Teacher Workshops

Private Universe Teacher Workshops

Grades 1-12
1995
Author: Matthew H. Schneps and Ara Sahiner

Ordering Information:
Annenberg/Corporation for Public Broadcasting (CPB)
PO Box 2345
South Burlington, VT 05407-2345
Fax: (802) 864-9846
Toll-free: (800) 965-7373
http://www.learner.org/

This video workshop, developed for science teachers, examines current research on how students learn science and the implications of that research for the classroom. The nine sessions of this workshop are the edited versions of a series of interactive teleconferences broadcast in the fall of 1994. All discussions are built around footage of college graduates discussing their ideas and the question of how students assimilate scientific concepts. Each program is structured as an experiment that investigates how a student's ideas change or do not change in response to a given teaching strategy. Through interviews with high school students and teachers, and scenes of classroom activities, the workshop demonstrates how a student's preconceived notions and ideas can pose critical barriers to learning science. Each workshop focuses on an educational theme and explores that theme by showing classroom examples from a specific grade level and posing a broad question within a specific science discipline. Workshop One, for example, asks about what causes the changing seasons. The program opens with a segment in which newly minted Harvard graduates, dressed in caps and gowns, discuss their theories for the causes of the seasons. The Harvard grads speak eloquently about their ideas, which are, for the most part, erroneous. From there, viewers go to a 9th grade astronomy class to see how teachers can elicit student ideas about the seasons. In another segment, the Harvard graduates demonstrate the differences between hands-on and minds-on science as they try to light a bulb using a battery and wires. Additional themes and topics include creating a concept map of students' ideas about photosynthesis (grade 7); exploring student understanding of an abstract concept such as what is found between particles of air (grades 3, 6, 8, and 10); and how a teacher can create a constructivist lesson plan about gravity and friction (grade 7). Each workshop consists of the following components: video clips of interviews with students and teachers as well as classroom teaching that illustrates the science education issues being discussed; a presentation of current science education research; and studio and remote discussions of the science education issues raised in the video clips. Explanations of the specific science concept being explored, examples of feedback fr[illegible] previous workshops, and activities to be completed during the workshop are also included. The teacher's guide is a print supplement to the video programs and includes a synopsis of each program, a review of the science model and a few of the historical ideas relevant to each workshop, and activities to be done prior to and during the workshop. (Author/LCT) ENC-012564

Sense Making in Science Video Series

Boats, Balloons, and Classroom Video: Science Teaching As Inquiry

Grades K-6
1998
Author: edited by Ann S. Rosebery and Beth Warren

Ordering Information:
Heinemann Educational Books, Inc.
361 Hanover Street
Portsmouth NH 03801-3912
Telephone: (603) 431-7894
Fax: (800) 847-0938
Toll-free: (800) 541-2086
custserv@heinemann.com
http://www.heinemann.com/

$21.00 per book (paperback)
Order # 000336-ENC

Elementary teachers describe their experiences of collaborating with educational researchers to conduct their own scientific investigations and to explore their students' scientific learning in the classroom. The teachers actively engaged in constructing their own knowledge in science and reflecting on how they might create similar experiences for their students. The essays in this book describe some of the important discoveries the teachers made and the profound effect this kind of experience had on their teaching practice. In one sample essay, Exploring Rust, Talking Science, a fourth grade teacher describes how she came to understand the importance of having her students talk about scientific ideas. These science talks helped students learn science and helped the teacher to better understand student thinking. For this essay, the author reviewed three years of audio tapes from her inner-city classroom and was struck with the serious tone her students adopted as they engaged in a class study of rust. The study began with a discussion to find out what the students knew about rust from previous experiences. The class then used their knowledge to create a list of variables and to build and test theories about the origins of rust. This investigative approach gave students an understanding of the processes scientists use when they attempt to solve complex problems. They also developed skills that apply to other situations. The model of professional development presented in this book places teachers' own questions, theories, and analyses at the core. The book is meant to illustrate how the practice of scientific inquiry can be used in the professional development of teachers. (Author/JRS) ENC-013620

Organizing Wonder: Making Inquiry Science Work in the Elementary School

Grades K-6
1998
Author: Jody S. Hall with Carol Callahan, Helen Kitchel, Patricia Pierce, Pedie O'Brien; editor, William Varner

Ordering Information:
Heinemann Educational Books, Inc.
361 Hanover Street
Portsmouth, NH 03801-3912
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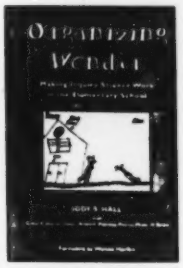
http://www.heinemann.com/

$17.00 per book (paperback)
Order # 00045-ENC

This professional development book describes the use of the inquiry process to teach science in elementary schools. It offers a practical guide to structuring the inquiry science process and includes in-depth case studies of the process in action. Also included are strategies for guiding students' inquiry without discouraging their excitement and curiosity. In one chapter, Seven Steps for Organizing Wonder, the authors explain a model for using exploration and investigation. In the first steps of the model, teachers identify key ideas and experiences on a topic, search for activities with potential for investigation, and introduce a series of initial student explorations. The process continues with the transformation of the students' ideas and questions into questions for investigation. This culminates in an analysis of the problem for fair-test potential, and, finally, in the students planning, implementing, and interpreting their investigations of the problem. Subsequent chapters describe the use of this process to investigate waves, bouncing balls, and light. The book concludes with the thought that time is needed to teach effectively with the inquiry science model. The authors advocate that since this model links science to language arts and quantitative reasoning, the case can be made for allocating that time needed for the inquiry process. References are included. (Author/JRS) ENC-013621



Teaching About Evolution and the Nature of Science

Grades K-12
1998
Author: Donald Kennedy, Bruce Alberts, Danine Ezell, Tim Goldsmith, Robert Hazen, Norman Lederman, Joseph McInerney, John Moore, Eugenie Scott, Maxine Singer, Marilyn Suiter, Rachel Wood

Ordering Information:
National Academy Press
2101 Constitution Avenue NW
Washington DC 20055
Telephone: (202) 334-3313
Fax: (202) 334-2451
Toll-free: (800) 624-6242
http://www.nap.edu/

$19.95 per book (paperback)
Order # 63647-ENC

The National Academy of Sciences (NAS) developed this book to summarize the observational evidence for evolution and suggest effective ways of teaching the subject. It explains the nature of science and describes how science differs from other human endeavors. Answers to frequently asked questions are provided and guidance is offered on how to analyze and select teaching materials. The book contains seven chapters and five appendices, along with three dialogs in which fictional teachers discuss the implications of the ideas discussed in the book. The first two chapters introduce the basic concepts of evolution and describe the supporting evidence. Chapter three addresses how the teaching of evolution ties in with teaching about the nature of science. In chapter four, the authors discuss how the *National Science Education Standards* apply to

Standards: National Science Education Standards (December 1995)

Funding: Howard Hughes Medical Institute; Esther A. and Joseph Klingenstein Fund, Inc.; National Academy of Sciences

the teaching of evolution and the nature of science. The book then goes on to answer some of the questions asked most frequently by students, parents, and educators. Chapter six provides eight sample activities and chapter seven outlines criteria that can be used to evaluate school science programs and instructional materials. In some of the activities, students use beads to simulate a populations growth over time; read and compare excerpts from original works by Lamarck, Wallace, and Darwin; and create timelines to represent geological time. Appendices include summaries of significant court decisions concerning evolution and creationism, position statements from professional organizations about the teaching of evolution, and references and resources. (Author/SSD) ENC-013634

internet resources

Role of Laboratory and Field Instruction in Biology Education

http://www.nabt.org/Laboratory.html

Grades K-12

Author: National Association of Biology Teachers (NABT)

At this Web site, visitors can read the official position statement of the National Association of Biology Teachers (NABT) on the role of laboratory and field instruction in biology education. Biologists recognize that knowledge based on experimental results and accurate observations is gained through a variety of experiences, including the pursuit of cause-and-effect relationships. Laboratory activities and inquiry provide students with opportunities to observe, sample, experience, and experiment with scientific phenomena in their quest for knowledge of living things. Laboratory and field study have also been demonstrated to be effective in promoting student comprehension and application of biological knowledge. Thus, the position statement asserts that study in a laboratory and/or field setting is an integral and essential part of a biology course. The site also lists recommendations regarding teaching strategies, physical resources, and curriculum development that will enhance the study of biology and improve the quality of biology instruction in schools. (Author/SSD) ENC-011234

Educational Technology: Support for Inquiry-Based Learning

http://ra.terc.edu/alliance/TEMPLATE/alliance_resources/reform/tech-infusion/ed_tech/ed_tech_frame.html

Grades K-12

Author: Andee Rubin
Publisher: TERC

Funding: National Science Foundation

This Web site, maintained by the Eisenhower Regional Alliance for Mathematics and Science Education Reform, features an online document that explains inquiry-based learning, discusses technology's potential role in it, and categorizes software products in terms of their relationship to inquiry-based learning. In section I, author Andee Rubin sets forth some common themes of inquiry-based learning, including constructivism, conceptual understanding, and metacognition, and addresses the effect it has on student learning. Section II presents a list of 12 different categories of software, such as information handling tools and educational games, and explains how each type of software does or does not support inquiry based learning. This section also includes specific examples illustrating the types of thinking and problem solving students might engage in while using each category of software. The paper provides a list of references and additional readings. (Author/JLH) ENC-009315

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Mathematics, Modeling Our World Series

Mathematics, Modeling Our World, Course 1

Grade 9
1998
Author: developed by COMAP, Inc.; editor, Landy Godbold; authors, Allan Bellman, John Burnette, Horace Butler, Claudia Carter, Nancy Crisler, Marsha Davis, Gary Froelich, Landy Godbold, Bruce Grip, Rick Jennings, Paul Kehle, Darien Lau10, Sheila McGrail, Geraldine Oliveto, Henry Pollak, J.J. Price, Joan Reinthaler, James Swift, Brandon Thacker, Paul Thomas

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http://www.swpco.com/

$53.95 per student book
$107.95 per annotated teacher's edition
$120.95 per teacher's resource binder
$53.95 per solution manual
$134.95 per video
$188.95 per hybrid CD-ROM
Note: Contact publisher for system requirements.

Standards: NCTM Curriculum and Evaluation Standards (1989)

Funding: National Science Foundation

This mathematics curriculum program offers students the opportunity to build, test, and present real-world mathematical models in the context of examining topics that include presidential elections, secret codes, and Olympics drug testing. The integrated series provides an interdisciplinary curriculum that introduces mathematical concepts as necessary tools for understanding our physical and social worlds. There are hands-on activities with specially designed computer programs on a CD-ROM, graphing calculator activities, and collaborative learning experiences designed to motivate and prepare all students for college or the world of work. Each unit of this nontraditional series begins with a short motivational video segment intended to stimulate student interest. For example, a unit from the grade 9 course, Prediction, is introduced with a video segment highlighting a forensic anthropologist using information obtained from a skeleton to aid in a criminal investigation. Also on the video segment is an explanation of the development and use of a linear equation that predicts a person's height from the length of his or her femur bone. In the unit, the goals are to explore bivariate data analysis and to further develop an understanding of linear relationships. Students identify patterns in data, describe linear relationships with equations, and learn to fit a line to data and then use the line to make predictions. In a sample lesson, students review data from the Florida Department of Environmental Protection about the incidence of manatee deaths due to powerboat accidents and decide whether to recommend limiting the number of powerboat registrations. Included with this kit are student and teacher texts; a teacher resource packet with blackline masters; a solutions manual; and the CD-ROM and video. Graphing calculators with a list function are an integral part of the instruction.

The CD-ROM contains software designed to help with the messy computations of real problems and to enhance concept development. Throughout the text, there are opportunities to evaluate student progress with oral reports, models and written summaries.

According to the authors, this program covers each of the NCTM standards. (Author/JRS) ENC-012892

Middle-School Mathematics Through Applications Project

The Antarctica Project: A Middle School Mathematics Unit

Grade 7
1995
Publisher: Middle-School Mathematics through Applications Project (MMAP), Institute for Research on Learning (IRL)

Ordering Information:
Institute for Research on Learning
66 Willow Place
Menlo Park, CA 94025
Telephone: (650) 687-7949
Fax: (650) 687-7957

$75.00 per book

Standards: NCTM Curriculum and Evaluation Standards (1989)

Funding: National Science Foundation

Students participate in a five-week Antarctic architectural design project in this unit from the *Middle-School Mathematics Through Applications Project* (MMAP), a National Science Foundation (NSF) sponsored curriculum project that seeks to place mathematics in a multidisciplinary context. In the Antartctica project, students are asked to design a scientific research station on the Antarctic coast. They are given specifications for the site and the station, information about the climate, and plans for future uses of the space to help them design an appropriate facility. One section helps students understand the principles behind a mathematical model, of which an architectural design and cost analysis is a special case. Students' communication skills are sharpened as they write their final reports to the fictional design firm that contracted them to design the station. Each section of the unit is introduced by an official memo from the agency to the students, explaining what is needed in each phase of the project. Student handouts and a letter to parents explaining the math unit are also included as resources for the teacher. Also available is ArchiTech, a Macintosh program that allows students to design the research station on the computer and calculate the costs of their designs. Assessment, planning, and implementation suggestions are included, as well as a map explaining how the unit satisfies each of the NCTM standards. (Author/RMK) ENC-012859

One and Only Common Sense [Cents] Series

Here's the Scoop: Follow an Ice Cream Cone Around the World

Grades K-3
1996
Author: Neale S. Godfrey, Randy Verougstraete, Marcia Miller, Martin Lee, Liz Kril

Ordering Information:
Modern Curriculum Press
Pearson Education
PO Box 2649
Columbus, OH 43216
Fax: (800) 393-3156
Toll-free: (800) 321-3106

The 22 activities in this unit deal with the concepts of consumer awareness and decision making about money, identification of coins and bills, and money transactions. The series has been created to initiate financial literacy by linking money concepts to real life in an engaging way. Through the adventures of the Green$treet$ Kids, children learn about money while exploring principles of economics and mathematics. In this book, sample activities include Cups, Cones, and Costs, in which children use critical thinking, number sense, and benchmark estimation to explore the idea of relative value. Another activity,

$137.50 per starter set
Order # 0-8136-4570-0-ENC-FAP99
Note: Starter set includes 1 big book, 6 student books, 1 teacher's guide, 1 read-along audio cassette, coin stamp set, and classroom coins and bills. Contact publisher for additional ordering information.

$36.25 per student book, 6-pack price
Order # 0-8136-4567-0-ENC-FAP99

$32.95 per big book
Order # 0-8136-0583-0-ENC-FAP99

Standards: NCTM Curriculum and Evaluation Standards (1989)

What's Cooking?, involves children in measuring, sequencing, using fractions, and counting to follow a recipe. Coin stamps are also included in this unit. In all units of the series, the activities are designed to follow National Council of Teachers of Mathematics standards by encouraging students to investigate ideas; make observations; manipulate coins and other objects; predict, graph, and analyze findings; summarize results; and engage in mathematical communication. Each unit comprises a children's book in two formats: a big book for whole-class story time and a student's book. Also included are a read-along cassette, a teacher's guide with plans for related activities, a money tray, and a game. In addition to activities, each guide provides an idea bank of related projects, reproducible activity masters, and home transaction letters. Informal assessment is encouraged through the use of Passbooks, personalized notebooks in which children can write or draw their responses to an activity and collect important papers. Masters for formal assessment are also provided. The units are associated with the Money Town game CD-ROM from the same series. (Author/GMM) ENC-008006

Interactive Mathematics Series

Against the Odds Classroom Instructional Resources

Grade 7
1995
Author: David Foster, Sandie Gilliam, Jack Price, Kay McClain, Barney Martinez, Linda Dritsas

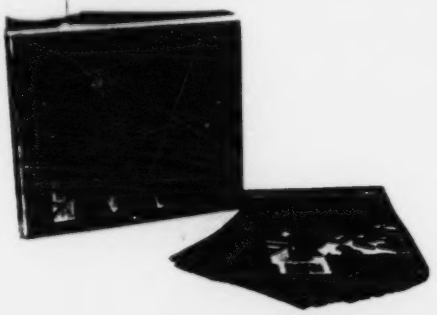
Ordering information:
Glencoe/McGraw-Hill
PO Box 543
Blacklick, OH 43004-0543
Fax: (614) 860-1877
Toll-free: (800) 334-7344
http://www.glencoe.com/

The Interactive Mathematics series is a program for middle grades that encourages students to construct their own mathematical understanding by using activities, projects, and investigations in a problem-solving, cooperative learning setting. Each unit opens with the story of a teenager who uses mathematics in a real-life situation. In this five-week unit, the teenager who introduces it is beginning a promising career in professional sports and uses mathematical calculations to choose equipment. Students complete seven activities and two investigations in which they design and play games and explore the relationship between actual and theoretical probabilities. In a sample activity, students investigate an actual situation involving probability (such as the state lottery) to determine odds and payoff values. Included are the student text pages, lesson plans, homework materials, a letter to parents with a family activity, and suggestions for assessment. Hardcover student texts are available in Spanish. (Author/JRS) ENC-011573

$82.16 per classroom instructional resources kit
Note: Includes teacher's edition, transparencies, menu station posters, and cooperative group discussion cards.

$30.22 per student resource book (English, Units 7-12)
Note: Spanish version $33.86

Standards: NCTM Curriculum and Evaluation Standards (1989)



The New Adventures of Jasper Woodbury Series

The Right Angle

Grades 5-8
1996
Author: Learning Technology Center, Peabody College, Vanderbilt University

Publisher: Learning, Inc.

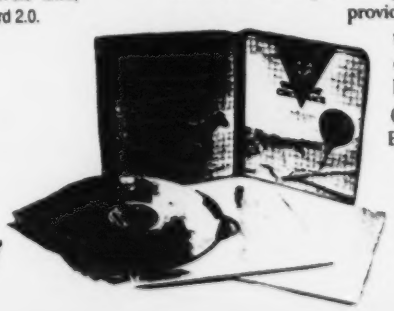
Ordering information:
Optical Data School Media
512 Means St NW, Suite 100
Atlanta, GA 30318
Telephone: (404) 221-4500
Fax: (404) 221-4520
Toll-free: (800) 524-2481
http://www.opticaldata.com/

$245.00 per laserdisc package (with Macintosh software)
Order # 266-4A-ENC

Standards: NCTM Curriculum and Evaluation Standards (1989)

System requirements: Laserdisc player with remote control, color monitor, barcode reader; Macintosh computer with 3.5" drive; Hypercard 2.0.

In the story on this laserdisc, a young Native American is challenged by her grandfather to find the cave where a family heirloom is hidden. As the story unfolds, students learn about topological maps, triangles, and the usefulness of geometry for measuring. The Jasper series is intended to develop problem-solving skills in contextual, real-life settings. Each of the nine episodes comes with a related teacher's manual that includes student materials and a computer software disk. At the beginning of each episode, students view a 15- to 25-minute movie introducing the fundamental concepts, the original story with characters, and the challenge. They then view several shorter movies that present directions, questions, and data. In this episode, students decode the directions to the cave given in the story, use their geometric knowledge to locate the cave on a map, and prepare clear directions for the rescue squad to find the fastest way to reach the cave. The mathematics involved includes whole number, fraction, and decimal operations; ratio, proportion, and percents; and similar triangles. The teacher's manual provides an activity preview, teaching suggestions, and a sample lesson plan. Student materials include pictures of characters, frame numbers of specific scenes, and a story summary. The software disk provides an optional function that allows viewers to select particular story scenes. (Author/CCC/JRS) ENC-013834



Focus on Algebra Series

Polynomial and Rational Functions: Building Boxes

Grades 9-12
1997
Author: produced by Bob Morris

Ordering Information:
Public Broadcasting Service (PBS)
PBS Mathline Orders
1320 Braddock Place
Alexandria VA, 22314-1698
Telephone: (703) 739-5071
Fax: (703) 739-7513
Toll-free: (800) 344-3337
shopeducation@pbs.org
http://www.pbs.org/learn/mathline/

Option I: **$399.00**
Note: Includes 1 set of 6 videos; lesson guides; participation in national listserv and online community. May be available from local PBS affiliate. Other options also available; contact MATHLINE for more information.

Standards: NCTM Curriculum and Evaluation Standards (1989); NCTM Professional Sstandards (1991)

Funding: United States Department of Education

Part of the Focus on Algebra series, this professional development video features a classroom lesson exploring relationships among x-intercepts, factors, and roots of polynomial functions using the graphing calculator. The video series, developed as part of the PBS MATHLINE High School Project (HSMP), includes 12 videos of lessons based on the National Council of Teachers of Mathematics (NCTM) standards. Also bundled with the series are 12 lesson guides that include student activity sheets, ideas for lesson extensions, discussion of mathematical topics, Internet connections, and pedagogical tips. HSMP's goal is to provide teachers with lessons that bring real-world applications, problem solving, and a student-centered, active learning approach to algebra topics that emphasize functions. In this lesson, students work in teams with calculators to investigate rational functions as they identify roots, asymptotes, and holes in the graphs. Students also use graph paper to construct boxes of various dimensions, then collect height and volume data and create a scatterplot to determine the height of the box with the maximum volume. In the video, the teacher discusses the use of questioning and the importance of a team setting for the lesson. An accompanying lesson guide provides detailed procedures, mathematical background, pedagogical ideas, and student worksheets for replicating the video lesson. (Author/JRS) ENC-012917

Math in Science Bundle

Grades 9-12
1997
Author: teacher's guide by Tony Kietrys, Tom Kudwa, David Holzwarth

Ordering Information:
PASCO Scientific
10101 Foothills Boulevard
Roseville, CA 95678-9011
Telephone: (916) 786-3800
Fax: (916) 786-8905
Toll-free: (800) 772-8700
sales@pasco.com
http://www.pasco.com/

$786.00 per kit
(Macintosh/Windows)
Order # CI-6785-044

The print materials and equipment in this kit are designed to be used with the Science Workshop computer program and interface. This interface enables students to collect and analyze data with a variety of sensors, including light, motion, and sound. The student workbook contains five tutorials introducing the use of sensors and the interface system. Also found in the workbook are 20 student experiments that apply mathematical topics, use data analysis, and investigate the relationship between mathematical formulas, variables, and graphs. Experimental topics include exponential growth and decay, the inverse relationship between light intensity and distance, and the development of graphic interpretations deriving from motion for the trigonometric functions, the derivative, and the integral. In a sample experiment, students heat a temperature sensor to 100 degrees and use the computer interface to record temperature versus time data as the sensor cools in open air. Applying the curve-fitting capabilities of the software, students discover that the best-fit curve for the cooling data is an exponential function. The teacher's guide contains all the student material with answers, and teacher notes with information and sample data for each experiment. There is a user's guide and video with detailed instructions for the installation and operation of the computer interface. (Author/JRS) ENC-012224

MathZones Series, Level C

Using Fractions, Decimals, and Percent

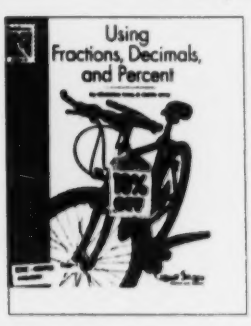
Grades 5, 6
1998
Author: Christine Losq

Ordering Information:
Great Source Education Group
Attn: Order Processing
181 Ballardvale Street
Wilmington, MA 01887
Telephone: (508) 661-1511
Fax: (800) 289-3994
Toll-free: (800) 289-4490
http://www.greatsource.com/

$19.95 per teacher's guide
Order # C3-044450

Standards: NCTM Curriculum and Evaluation Standards (1989)

The activities in this resource book are designed to help students to understand how decimals, fractions, and percent interconnect. The series presents project-based learning activities that help students make sense of mathematics through hands-on experiences with manipulatives, through literature-based problem solving, and through journaling. Students work in pairs or small groups to complete an activity and to present their solution strategies. Lessons in this book review and expand students' knowledge of place value, decimal points, and comparing and ordering decimals. The goal is for students to develop mastery of decimal, fraction, and percent computations and to connect computation to number sense and efficient consumer skills. Occasional literature-based lessons provide students with opportunities to connect new learning with prior knowledge. The book *The Toothpaste Millionaire*, for example, helps students to understand the stock market. Using a handout, students track 100 shares of a company's stock for a week, then create a line graph of the results. A second handout tracks a $1,000 investment in another company. A line graph is also created to represent this data. Throughout the



resource book, students are asked to explain, orally and in writing, their understanding of fractions, decimals, and percents. For the last lesson students create a mini-portfolio so that they can assess their own learning. Each lesson lists needed materials, objectives, and ideas for starting and closing a lesson. Also included are teaching tips that offer advice on classroom management, questions to facilitate discussion, extension activities, and/or informal assessment ideas. Activity sets are accompanied by actual student responses to the activities and/or samples of student work. Suggestions for assessment include an evaluation checklist to record each student's progress in the areas of math concepts, strategy development, and communications skills. This book contains reproducible blackline masters and a bibliography listing compatible literature materials. (Author/LDR) ENC-009713

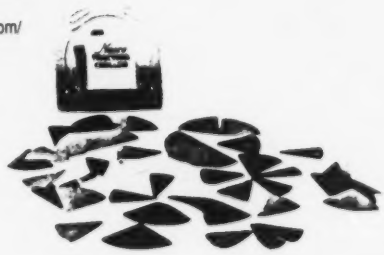
Fraction Circles

Grades 2-9
1996

Ordering Information:
Nasco
901 Janesville Avenue
PO Box 901
Fort Atkinson, WI 53538-0901
Telephone: (920) 563-2446
Fax: (920) 563-8296
Toll-free: (800) 558-9595
info@nascofa.com
http://www.nascofa.com/

$3.95 per set
Order # TB16618T

This kit of manipulatives contains pie-shaped partitions of a circle with a diameter of 3.5 inches. Partitions include a whole, halves, thirds, fourths, fifths, sixths, eighths, and twelfths; each partition has its own distinct color. (Author/GMM) ENC-007353



Tabletop Jr.

Grades 3-6
1995
Author: TERC, Inc.; project director, Chris Hancock

Ordering Information:
Broderbund Software, Inc.
500 Redwood Blvd
Novato, CA 94948
Telephone: (415) 382-4400
Fax: (415) 382-3030
Toll-free: (800) 521-6263
http://www.broderbund.com/

$99.95 per software package (Macintosh or Windows)
Note: Only available in combined packaging with Tabletop Sr. Please specify platform.

Standards: NCTM Curriculum and Evaluation Standards (1989)

Funding: Jostens Learning Corporation; Broderbund Software, Inc.; National Science Foundation

System requirements:
Macintosh: 2 MB RAM; 3.5" floppy drive; System 7.0 or higher

Windows: Windows 3.1 or higher; 3.5" floppy drive; VGA monitor

Tabletop Jr. introduces students to basic mathematics concepts, including data visualization, grouping, sorting, classifying, and graphing. Students also gain experience with interpreting data, logical reasoning, and patterns. Applying these concepts, students use their imaginations to create unusual creatures and objects, such as the Snoods, characters whose variables are their physical characteristics (type of hair, eyes, nose, feet). Children may also create pizzas, using any combination of toppings to learn sorting and classifying skills. The creations can be sorted in seven ways: free form, bunched by attributes, stacked by attributes, axes (scatter plot and cross tab graphs), loops (Venn diagrams), linked by their like characteristics (chains), or in grid formation (tiling). The teacher's manual includes lesson plans that may function as a single lesson or as part of open-ended investigations. It also includes more than 50 illustrated challenge cards of varying difficulty, each with a game or puzzle that may be solved using the program or physical manipulatives. Software users may choose English or Spanish language when they begin the program. The program is designed to support the National Council of Teachers of Mathematics (NCTM) standards. (EPIE Institute/RMK) ENC-005157

Addenda Series, Grades 9 to 12

Algebra in a Technological World

Grades 9-12
1995
Author: M. Kathleen Heid with Jonathan Choate, Charlene Sheets, Rose Mary Zbiek

Intended for teachers, supervisors, curriculum developers, and teacher educators, this book addresses the teaching and learning of high school algebra in light of the National Council of Teachers of Mathematics (NCTM) standards documents and the dramatic changes caused by graphing calculators and computer software. More than 18 classroom-tested activities shift students and teachers away from paper-and-pencil exercises toward using algebraic functions and mathematical modeling to explore

Ordering Information:
National Council of Teachers of Mathematics, Inc.
1906 Association Drive
Drawer A
Reston, VA 20191-1593
Telephone: (703) 620-9840
Fax: (703) 476-2970
Toll-free: (800) 235-7566
orders@nctm.org
http://www.nctm.org/

$15.00 per book
Order # 467-ENC

Standards: NCTM Curriculum and Evaluation Standards (1989)

real-world situations. The first section of this book addresses how graphing calculators and computer algebra systems offer new ways of using algebra that enable students to explore, describe, and explain quantitative relations in their world. The next section explores how the new methods and technologies interact to support new curricular goals. Chapters three and four elaborate in detail a modeling and functions approach to algebra. Connections between algebra, geometry, and discrete mathematics are discussed in chapter five, and the final chapter clarifies distinctions among symbol sense, symbolic manipulation, and symbolic reasoning in a technological world. Most of the activities include reproducible blackline masters, as well as margin notes that provide teaching suggestions, assessment strategies, and ideas for lesson extensions. Solutions for the activity problems are provided. The ideas, examples, illustrations, and activities presented in this book are designed to demonstrate the interrelationships of the unifying themes of the National Council of Teachers of Mathematics standards. (Author/DDD) ENC-002691

Sunshine Math Series

Sunshine Math, Superstars III: Saturn 5

Grade 5
1998
Author: Sunshine Math Program; revisions by Sandy Berger, Frankie Mack and Linda Fisher with input from Andy Reeves

Ordering Information:
Panhandle Area Educational Consortium (PAEC)
Attn: Jean Chance
753 West Boulevard
Chipley, FL 32428
Telephone: (850) 638-6131
Fax: (850) 638-6336
E-mail: chance@paec.org
http://www.paec.org/

Sunshine Math is a structured program designed to fit into the existing curriculum and to provide extra mathematical challenges with higher-order thinking activities for self-motivated students. Saturn 5, part of its Superstars III enrichment program, is a resource binder of 27 activity sheets for grade 5 mathematics featuring problems that include extending patterns, finding area for irregular figures, and using charts and graphs. The weekly activity sheets are designed to stimulate discussion of problem-solving strategies. In one activity, students are encouraged to draw a picture to help them find the solution to this problem: "How long does it take a worm to crawl up a 10-foot hill if it crawls up four and one-half feet each day and slides down two and one-half feet each night?" Other problems involve

$11.93 per book
Order # 102035-enc

$99.00 per set (K-8)
Order # 102029-ENC

Funding: Florida Department of Education; Dwight D. Eisenhower National Mathematics and Science Education Program

magic squares, inequalities, and Venn diagrams. The answer section contains commentary on each problem and suggestions for parallel problems to help stimulate discussion. The general information on how to organize the program includes an explanation of the basic weekly procedures and lists of suggestions for principals, teachers, and assisting adults. Also included are an agreement for students to sign and a letter to parents explaining the program philosophy. (Author/JRS) ENC-013559

Life in the Universe Series

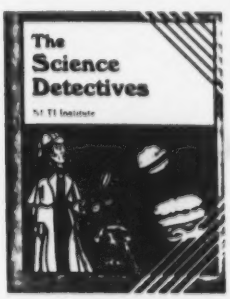
Science Detectives

Grades 3, 4
1996
Author: SETI Institute; series production editor, Kevin W. Perizzolo

Ordering Information:
Teacher Ideas Press/ Libraries Unlimited
PO Box 6633
Englewood, CO 80155-6633
Telephone: (303) 770-1220
Fax: (303) 220-8843
Toll-free: (800) 237-6124
http://www.lu.com/tip/

$54.00 per kit
Order # 323-x-ENC
Note: Includes book, video, and full-color poster.

The Search for Extraterrestrial Intelligence (SETI) Institute developed Science Detectives to help students learn about astronomy, the solar system, and states of matter. The kit uses hands-on activities such as experiments and art projects to help students learn about the order, relative sizes, and distances between planets in our solar system; the composition and characteristics of the planets; and orbits and natural satellites. Students also learn the characteristics of lenses and telescopes, discover the phases of the moon, and learn the differences between the inner rocky planets and outer gas giants. The activities are presented as a series of seven missions that require students to use clues about the planets to build scale models and convert them to actual size; use Venn attribute diagrams to group planets; and construct and use a telescope to find planets in the real sky. In other activities, students use a scale model to compare the orbit times of the planets with a Cosmic Wheel and decode a message of extraterrestrial origin. The missions are tied together by the fictional story presented in the video. The first segment introduces the challenge: to track Amelia Spacehart's borrowed space craft as she searches for the source of an extraterrestrial message. Dr. Orbit, a fictional NASA scientist, and his boss, Buzz Sawyer, provide helpful information and humor. Each subsequent video segment begins with a confirmation of what students have discovered from Amelia's previous clue, provides new information, and presents a new clue. The poster contains color illustrations of the planets. Portions of the images have been omitted so that, by completing the picture, students can display their knowledge of the planets. The teacher's



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guide provides background information, masters of student log books, and directions for assessing student projects. (Author/LCT) ENC-007330

RealiZation Technology Series

The Cat on the Chimney: Solving Problems with Technology

Grades 4-7
1992
Author: David Drew; illustrated by Robert Roennfeldt; series editor, Stephen Moline

Ordering Information:
Rigby
Customer Service
PO Box 797
Crystal Lake, IL 60039-0797
Fax: (800) 427-4429
Toll-free: (800) 822-8661
http://www.rigby.com/

$36.00 per set of 6 small books
Order # 53434

$35.00 per big book
Order # 06290

$284.00 per package
Order # 63510
Note: This package contains 4 big books and 24 small books.

This big book kit contains six open-ended technology puzzles that help students develop their general problem-solving skills, measurement skills, and logical thinking. The series uses an interactive, problem-solving approach to teach children basic science concepts through shared book experiences. Each kit in the series includes a science information big book and a set of six small books. The book in this kit was written to foster creative problem solving and active use of the imagination. Each two-page spread presents students with a predicament and a variety of household tools and technology with which to solve the problem. In a sample scenario, students design a rescue device to get a frightened cat down from a chimney. The colorful illustrations depict a 15-pound cat trapped on a chimney three stories high, a tree that can bear a maximum of 40 pounds, and approximately 20 tools that include 100 feet of rope, an aluminum can of sardines, a six-foot ladder, and a magnet. The minimal text includes captions, scale bars, and units of measurement. A teacher's resource book for the whole series (available separately) provides suggestions for introducing the big books, for sharing them with the whole class, and for using the small books to help students read with a partner. It also provides discussion questions, guidelines for assessing problem-solving skills, and ideas for implementing children's solutions in the class. In a series of writing assignments, students are given the opportunity to explain their solutions. The resource book also describes the benefits of reading, writing, and talking across the curriculum and provides suggestions for directing student research, assessment, and involving families in their children's learning. (Author/LCT) ENC-013420

RealiZation Technology Series

Alone in the Desert: The Science of Survival

Grades 5-8
1992
Author: David Drew; illustrated by Mike Gorman

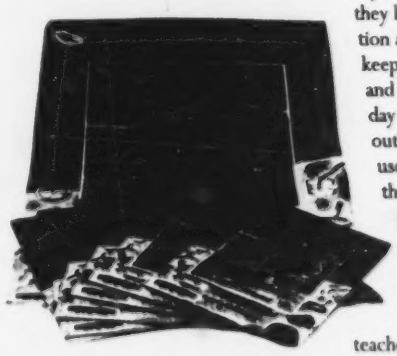
Ordering Information:
Rigby
Customer Service
PO Box 797
Crystal Lake, IL 60039-0797
Fax: (800) 427-4429
Toll-free: (800) 822-8661
http://www.rigby.com/

$36.00 per set of 6 small books
Order # 53430

$35.00 per big book
Order # 06339

$284.00 per package
Order # 63510
Note: This package contains 4 big books and 24 small books.

Part of the series described above, this book kit encourages students to use their knowledge of science and technology to plan their own desert rescue and survival strategies. Students are presented with a scenario in which their car has broken down, stranding them in the desert for five days. Each day offers a new set of role play activities and experiments that challenge students to find water, cook food, and maintain their body temperature as they find their way to civilization. For the first day, the book provides general guidelines for building a solar still that will condense the water evaporated from pieces of desert plants. A map shows students their location in the desert and the types of soil and rock available. It also includes a diagram of a simple solar still with four design flaws that prevent it from working. After students examine the pictures and redesign the still, they use their plans to build a real still that works. As the book progresses, the problems become more complex and less defined. On the second day, students are presented with the basic concept of a solar oven and an illustrated list of materials; on day three they are asked to use what they know about reflection and insulation to keep cool during the day and warm at night. On day four, they have run out of water and must use what they find in the car to build a compass, tell time, and estimate distance. Sample solutions are provided in the back of the book. The teacher's resource book (available separately) provides ideas for experiments in which students test their survival solutions. (Author/LCT) ENC-013421



Minds-On Physics (MOP) Series

Motion: Activities & Reader

Grades 11, 12
1999
Author: William J. Leonard, Robert J. Dufresne, William J. Gerace, Jose P. Mestre

Ordering Information:
Kendall/Hunt Publishing Company
4050 Westmark Drive
PO Box 1840
Dubuque, IA 52004-1840
Fax: (800) 772-9165
Toll-free: (800) 770-3544
http://www.kendallhunt.com/

$15.99 per book
$34.99 per teacher's guide

Standards: National Science Education Standards (NSES) (December 1995)

Funding: National Science Foundation

Through inquiry and hands-on activities, this teacher's guide and student book explore the meaning of interactions. The Minds-On Physics series aims to integrate conceptual knowledge within problem solving contexts so that students develop conceptual understanding of physics while improving problem-solving proficiency. The approach is action-oriented and based on social constructivism theory. The student book contains 35 activities beginning with a series introducing position and moving through measurement of velocity and into acceleration and problem solving in kinematics. The system is designed so that the students carry out the activities first and develop concepts before reading the sections at the end of the book which give descriptive information about the concepts studied. The teacher's guide provides information on using this type of curriculum, the role of the teacher, and ideas for both formative and summative assessment. For each activity, suggestions are made for how to organize the classroom and carry out the investigation. Questions to stimulate class discussion are supplied along with common student problems and misconceptions and answers to questions and problems. Blackline masters of answer sheets for each activity may be copied for students to use in data collection. (Author/SSD/KSR) ENC-013054

Ultimate Science Kit

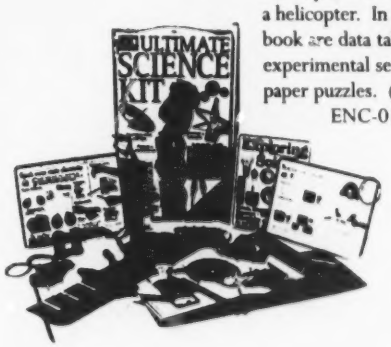
Grades 3-9
1997
Author: editor, Anne Marie Ryan

Ordering Information:
DK Publishing, Inc.
Customer Service
7800 Southland Boulevard #200
Orlando, FL 32809
Fax: (407) 888-1879
Toll-free: (800) 986-9921
http://www.dk.com/

$49.95 per kit

System requirements: Need 1 normal 9-volt battery (not rechargable).

Designed for home use, this kit provides instructions and materials for a variety of physical science experiments. It includes a set of experiment cards, an illustrated instruction booklet, a scientist's notebook, and a set of press board models. It also contains an equipment kit with an electronic circuit board, wires, and resisters; a prism, optical fibers, and iron filings; and a motor, magnets, and marbles. The experiments are divided into eight major categories that include air and water, sound and light, electricity and magnetism, and forces and energy. Additional topics include heat, machines, and color. In sample experiments, students use the materials provided to make a Cartesian diver, construct a drum and a set of Pan pipes, and test a variety of materials to discover whether they conduct electricity. The press board models include the pieces for putting together a zoetrope, a color spinner, a glider, and a helicopter. In the scientist's notebook are data tables, line diagrams of experimental set-up, and pencil and paper puzzles. (Author/LCT) ENC-013384



Minds-On Physics (MOP) Series

Conservation Laws & Concept-Based Problem Solving: Activities & Reader

Grades 11, 12
1999
Author: William J. Leonard, Robert J. Dufresne, William J. Gerace, Jose P. Mestre

Ordering Information:
See preceding record.

$15.99 per book
$34.99 per teacher's guide

Standards: National Science Education Standards (NSES) (December 1995)

Funding: National Science Foundation

Part of the series described above, this teacher's guide and student book explore the meaning of conservation laws (momentum and energy) through inquiry and hands-on activities. The student book contains 32 activities, beginning with a series introducing collisions and momentum, moving through work and energy, and delving into concept-based problem solving. (Author/SSD/KSR) ENC-012934

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Physics 98 Institute

http://www.owu.edu/~mggrote/Phys98/

Grades 6-12

Author: webmaster, Christopher M. Grote; workshop director, Michael Grote; Barbara Andereck, Bill Heinmiller
Publisher: Ohio Wesleyan University

The participants of Physics 98 Institute, a summer institute for teachers hosted at Ohio Wesleyan University, attended to learn about different and interesting methods of teaching physics with an emphasis on inquiry-based learning. This Web site provides photographs from the Institute, an introductory essay about inquiry learning, and a series of 20 lesson plans developed for grades 6 to 12. In a sample lesson, students construct a bottle rocket using a two-liter pop bottle. They then launch their rocket and find its altitude and maximum velocity. In another activity, students design and build a cask for a raw egg, demonstrate the integrity of their cask design, and explain the important factors engineers must consider when designing a cask for the transport of spent nuclear fuel. Each activity summarizes key mathematics and science concepts and provides an overview, background information, and instructions. Extension activities, assessments, and worksheets are also provided. Abstracted 11/98. Winner, ENC Digital Dozen, December 1998. Netscape Navigator 4.x recommended; some lesson plans require Adobe Acrobat Reader for viewing. (Author/LCT) ENC-013488

Advanced Biology

http://www.cascadehs.csd.k12.id.us/advbio/home.html

Grades 11, 12

Author: Advanced Biology Class at Cascade High School; webmasters, Ben Plehal, Jessica Byrd
Publisher: Cascade High School Advanced Biology Class

The Advanced Biology class at Cascade High School maintains this online archive of student environmental action projects. Cascade High School is situated on the shores of Cascade Reservoir, a highly impacted body of water in central Idaho. Advanced Biology is a project-oriented course in which students learn the fundamentals of limnology and use their knowledge to propose and implement a solution to a specific aspect of Cascade Reservoir's problems. In addition to designing their own research, the students are challenged to gather public and expert support to implement their proposals and to write grants to secure funds for their projects. They also share their data over the Internet, participate in field work with water-quality experts at federal and state levels, and attend public hearings regarding the future of Cascade Reservoir. Finally, the students write a paper about their project, which is featured on the Web site. The Sewage Sisters' Biocoil Project, for example, is a four-year study conducted by a group of girls to design, construct, and test a photosynthetic bioreactor used to remove nutrients from waste water. Another project modified the biocoil into a home version for growing algae to harvest and eat. Abstracted 11/98. (Author/LCT) ENC-013462

Carolina Coastal Science

http://www.ncsu.edu/coast/

Grades 4-12

Author: Alec M. Bodzin
Publisher: North Carolina State University

Standards: National Science Education Standards (NSES) (December 1995)

This Web site is a resource for exploring environmental science in coastal Carolina with students of all grade levels. It contains pictures, video clips, and activities to involve students in exploration, independent research, inquiry, and debate. An educator's guide features detailed teaching suggestions for using the site in both primary and secondary schools. Also included are student worksheets and assessment materials. In the site's major activity, the Shell Isle Dilemma, students work in expert groups using environmental data to determine how to protect an oceanfront structure threatened by coastal erosion. Students place themselves in the role of one of the stakeholders and complete position statements during their investigation. A variety of different issues in science, social studies, and geography are raised in the documents included with this activity. This site also contains pictures with related questions chosen to prompt environmental discussions. Another section is designed to show students how a variety of scientific technology equipment is used on research vessels on the Carolina coast. (Author/JRS) ENC-013414

Hello Dolly: A Webquest

http://powayusd.sdcoe.k12.ca.us/dolly/default.htm

Grade 11 and up

Author: Keith Nuthall
Publisher: Poway Unified School District

At this Web site, students can participate in an inquiry-oriented activity to learn about the implications of cloning. The site describes a scenario in which the United States House of Representatives is assembling a group of specialists to investigate cloning's widespread implications for all of American society. Each team of specialists will present their findings to a special subcommittee, which will evaluate the Human Cloning Prohibition Act and determine if the bill should be expanded to include other types of cloning. The teams include the U.S. Department of Agriculture, which will focus on the benefit of cloning on the nation's food supply; a nationally recognized group of citizens that promote the humane treatment of animals; professors of biomedical ethics; and a pharmaceutical company committed to the advancement of pharmaceutical products using cloning. For each expert panel, the Web site provides a dossier that defines both the role of the group and the tasks of each member, a list of questions to answer, an action plan for a brief presentation, and practical advice on public speaking. The site provides guidelines for brainstorming ideas, assigning tasks, and finding information on the Web. Links to cloning and genetics related resources are also provided. Winner, ENC Digital Dozen, January 1998. (Author/LCT) ENC-011210

Explore the GLOBE Program

http://globe.fsl.noaa.gov/

Grades K-12

Author: Global Learning and Observations to Benefit the Environment (GLOBE) Program; GLOBE visualizations hosted by NASA's Goddard Space Flight Center

Publisher: National Oceanic and Atmospheric Administration (NOAA), Forecast Systems Laboratory and National Geophysical Data Center

Global Learning and Observations to Benefit the Environment (GLOBE) is a network of K-12 students and teachers from more than 3,000 schools in 39 countries who collaborate with research scientists to learn more about our planet. GLOBE students make a core set of environmental observations at or near their schools and report their data via the Internet. Scientists use GLOBE data in their research and provide feedback to the students to enrich their science education. Each day, images created from the GLOBE student data sets are posted on the GLOBE Web site. The goals of GLOBE science and education activities are to help students reach higher levels of achievement in science and math and to increase the environmental awareness of all individuals while increasing their scientific understanding of Earth. Topics include atmospheric temperature, biometrics, cloud observations, land cover, precipitation, surface water temperature, and pH. In sample activities, students interpret satellite data, produce land-cover classification maps, and assess their landscapes for biologically important parameters. Students also collect and analyze data on atmospheric composition and trace gases and make observations about clouds, temperature, and preciptation. In another activity, they measure ultraviolet radiation using a photochemical dosimeter. Winner, ENC Digital Dozen, September 1995, November 1996, May 1998. (Author/LCT) ENC-009304

EnviroNet Monitoring Projects

http://earth.simmons.edu/monitoring_projects/index.html

Grades 5-12

Publisher: Department of Biology, Simmons College
Author: developed by EnviroNet

Funding: National Science Foundation

EnviroNet is a network of teachers, scientists, environmental educators and others who utilize telecommunications to enhance environmental science education. It began in 1992 as a Teacher Enhancement Project at Simmons College in Boston. On the Web site, timetables and short descriptions are given for each project, along with detailed procedures for data collection and contact information. Data collection is organized into three levels: entry-level participants perform simple experiments and send their raw data to the project coordinator over the Internet; exploratory-level participants perform slightly more advanced experiments and do simple data analysis over an online spreadsheet; and at the research level, which students attain after completing the first two, participants design their own experiments, analyze the data, and send it to the project coordinator. Samples of ongoing projects include monitoring of pH levels for all forms of precipitation (Acid Rain); a BirdWatch project in which data is collected on bird populations at feeders in two week intervals, and ends with a nest box activity in the spring; and the Ozone project, which uses the EcoBadge for determining local levels of ozone in parts per billion (ppb). Background information and templates for activity sheets are provided. Winner, ENC Digital Dozen, March 1996. (Author/LCT) ENC-004122

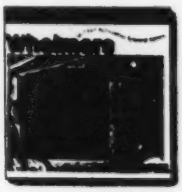
Whelmers

http://www.mcrel.org/whelmers/

Grades K-12

Author: Steven L. Jacobs
Publisher: Mid-continent Regional Educational Laboratory (McREL)

Standards: National Science Education Standards (NSES) (December 1995)



This Web site offers 20 teacher demonstration activities (Whelmers) that are intended to "whelm" students by sparking their curiosity about science. Whelmers are designed to engage students and to draw their attention away from the incredibly busy and hurried lifestyle we all experience. These activities are based upon activities contained in Whelmers, Volume I by Steven L. Jacobs and have been aligned with the National Science Education Standards (1995). In a sample activity, the Balloon Vacuum, a balloon is mysteriously sucked into a flask to demonstrate the relationship between air pressure and the heat and volume of a gas. An Inch of Skin shows students how to locate different types of nerve receptors in their skin; and Falling Test Tubes? uses two glass test tubes and water to create a discrepant event that demonstrates adhesion and cohesion. An additional activity, Pretzel Predictions, demonstrates concepts in digestive physiology and absorption by challenging students to predict how many pretzels they can eat in a minute. Each activity is accompanied by an overall description and the science process skills incorporated into the activity, as well as complex reasoning strategies, concept topics, and materials and instruction. In addition, each activity is also cross-listed according to the specific NSES standards. Suggestions are provided for individual and group assessments, as well as information about Whelmers workshops and materials. Abstracted 10/98. Winner, ENC Digital Dozen, June 1996. (Author/LCT) ENC-001096

Middle School Institute for Math-Science Integration

http://www.owu.edu/~mggrote/MSI2/

Grades 5-8

Author: Michael Grote; site created and maintained by Christopher Grote
Publisher: Ohio Wesleyan University

Designed for middle school teachers, this Web site provides examples of lesson plans that use an inquiry approach in integrating math and science instruction. Each lesson begins with a prompt, such as an anecdote or an attention-getting demonstration, to stimulate student interest in the topic. For example, a lesson on kinetic and potential energy might start with a prompt about roller coasters. A promotional film or an amusement park Internet site might be used to stimulate student interest. After the prompt, students brainstorm a list of possible investigations about the topic. Students then work in groups to investigate one of the ideas from the list and present their results to the class. In other lessons, students explore the components of different soil samples and collect leaves from various trees and attempt to identify the type of tree using various classification techniques involving leaf shape and venation. They also use inquiry and problem solving to develop their understanding of the invention process. Each lesson plan includes an overview, prerequisite background information for students, and a sample prompt for opening the inquiry. Extension activities, assessments, and reproducible student worksheets are also provided, as well as links to state and national standards. This site is best viewed with Netscape Navigator 4.x. Abstracted 01/99. (Author/LCT) ENC-013836

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Welcome to the Monarch Watch!

http://www.MonarchWatch.org/

Grades K-8

This Web site covers the migration of the Monarch butterfly. The goals of Monarch Watch are to further science education—particularly in primary and secondary school systems; to promote conservation of monarch butterflies; and to involve thousands of students and adults in a cooperative study of the Monarch's fall migration. Students involved in tagging and rearing Monarchs are given the opportunity to learn hands-on science and explore migration with the help of hundreds of volunteers. At this Web site, students can find news including tag recovery data, population dynamics, and migratory season summaries. Also provided are a FAQ section and information such as butterfly rearing, the science of tagging, and scientific journal articles. Monarch life history is outlined and conservation efforts are presented. A milkweed (the Monarch's host plant) handbook is available online, as are several curricula that are currently in development. The curricula include role-playing activities, vocabulary, and butterfly life cycles. Winner, ENC Digital Dozen, September 1995. Magellan 4-Star site. (Author/DEB) ENC-002473

Monarch Watch Print Guides

Monarchs in the Classroom

Monarchs in the Classroom: An Inquiry-Based Curriculum for Grades K-2

Grades K-2
1997
Author: Karen Oberhauser and Liz Goehring

Ordering Information:
University of Minnesota
Twin Cities Campus
Karen Oberhauser
Department of Ecology, Evolution and Behavior
1987 Upper Buford Circle
St Paul, MN 55108-6097
Telephone: (612) 624-8706
Fax: (612) 624-6777
oberh001@tc.umn.edu
http://www.MonarchWatch.org/

$16.50 per book
Order # CK2-enc
Note: Purchase orders over $50 accepted.

Standards: National Science Education Standards (NSES) (December 1995)

Funding: National Science Foundation; University of Minnesota; Medtronic STAR Foundation

This teacher's guide, part of the Monarchs in the Classroom series, contains lessons introducing grade K-2 students to the life cycle of Monarch butterflies and their relationship to the environment. The series is a K-9 supplemental science curriculum designed to be interdisciplinary and inquiry-based. The curriculum is divided into six sections including migration, experiments, and conservation. This teacher's guide provides extensive background information on Monarchs, their host plants, and their predators. In sample activities, students observe the development of Monarch larvae, record eating and growth data, and make a caterpillar book as a record of their project. Also included are a vocabulary section, drawings and diagrams that can be copied for student handouts, and a bibliography. (Author/JRS) ENC-013623

Monarchs in the Classroom

Monarchs in the Classroom: An Inquiry-Based Curriculum for Middle School

Grades 5-8
1997
Author: Karen Oberhauser and Liz Goehring

Ordering Information:
University of Minnesota
Twin Cities Campus
Karen Oberhauser
Department of Ecology, Evolution and Behavior
1987 Upper Buford Circle
St Paul, MN 55108-6097
Telephone: (612) 624-8706
Fax: (612) 624-6777
oberh001@tc.umn.edu
http://www.MonarchWatch.org/

$16.50 per book
Order # CMS-enc
Note: Purchase orders over $50 accepted.

Standards: National Science Education Standards (NSES) (December 1995)

Funding: National Science Foundation; University of Minnesota; Medtronic STAR Foundation

This teacher's guide contains lessons introducing middle school students to the life cycle and ecology of Monarch butterflies. In sample activities, students learn how scientists classify organisms into groups. They practice classification by sorting their shoes according to their own classification systems and by sorting animals into groups. There are also lessons that emphasize the large number of insects in the animal kingdom, teaching students how their worldview is biased towards animals with backbones. Students use art as they research and report on the origins of scientific names for organisms. (Author/JRS) ENC-013624

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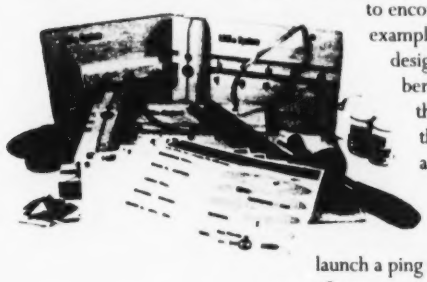
LINX System

Grades 4-8
1997

Ordering Information:
The Science Source
PO Box 727
Waldoboro, ME 04572
Telephone: (207) 832-6344
Fax: (207) 832-7281
Toll-free: (800) 299-5469
info@thesciencesource.com
http://www.thesciencesource.com/

$188.00 per kit
Order # 2125-ENC

The materials and instructions in this design technology kit comprise an open-ended, wood-based building and construction system that enables young students to use real tools safely and accurately. Students begin by constructing a simple, balloon-powered land yacht, and then expand their designs to incorporate pulleys, gears, and cams. The preliminary activities are followed by a series of more than 30 design challenges that ask students to design and construct a variety of vehicles, buildings, simple machines, and pneumatic or hydraulic devices. These challenges are designed to develop problem-solving skills and to encourage creativity. For example, students are asked to design and construct a rubber-band-powered vehicle that will travel at least three meters; a model of a house with an alarm system that is activated by opening the door; and a catapult that will launch a ping pong ball 10 feet to hit a specific target. As a culminating challenge, students are asked to design a survival system that will enable them to obtain water from a deep chasm and food from the opposite side of the chasm. Each set of instructions is accompanied by three-dimensional illustrations. (Author/LCT) ENC-013514



Zometool Explorer Kit

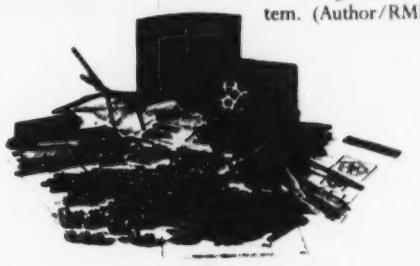
Grades 1-12
1998

Ordering Information:
Zometool
1526 South Pearl Street
Denver, CO 80210
Telephone: (303) 733-2880
Fax: (303) 733-3116
Toll-free: (888) 966-3386
sales@zometool.com
http://www.zometool.com

$64.95 per student's kit
$19.95 per lesson plans manual

Standards: Benchmarks for Science Literacy (1993); NCTM Curriculum and Evaluation Standards (1989)

The Zome system in this kit includes struts and Zome balls that can be used to build geometric, architectural, biological, and chemical structures. There are three types of struts that connect to the Zome balls in precise and predetermined ways so that students can build objects such as buckyballs and be certain that the angles are precise. The accompanying lesson plans provide ways for implementing activities that help students explore mathematical and scientific concepts such as the Platonic solids, angles, and similar triangles. Each activity gives complete and illustrated instructions as well as a description of the lesson's objectives and the standards addressed. For example, in one activity students explore the idea of minimal surfaces using the Zome system and a bubble solution. Students build a structure such as a pyramid and then dip it into the bubble solution, observing as the bubble solution forms a minimal surface inside that structure. A Web site offers additional ideas for activities as well as a teacher's forum for discussing ideas using the Zome system. (Author/RMK) ENC-013520



K'NEX in the Classroom

Roller Coaster Physics

Grades 8-12
1997

Ordering Information:
K'NEX Educational Division
2990 Bergey Road
PO Box 700
Hatfield, PA 19440-0700
Telephone: (215) 997-7722
Fax: (215) 996-4222
Toll-free: (888) 222-5639
abcknex@knex.com
http://www.knex.com/

$250.00 per kit (includes teacher's manual, K'NEX, instructions, container)
Order # 79301-ENC

Using the supplemental, hands-on activities in this curriculum kit, students investigate physics concepts in simple systems first, then apply these concepts to build a complex roller coaster system. The kit contains more than 3,000 K'NEX rods, connectors, and gears in addition to a teacher's guide with 10 modules that explore forces, motion, and energy through investigation, experimentation, measurement, and data analysis. In the first modules, lab groups use the materials to build inclined planes and ball loops, and then investigate projectile motion, speed, and friction by changing variables on their models. As the students work cooperatively to build the roller coaster's ramps, spirals, and loops, they learn about roller coaster physics and derive formulas through experimentation. Each module contains background information and worksheets for concepts and calculations. The background section provides a brief overview of relevant physics principles and equations, practical examples, and suggestions for implementing each module. The concepts worksheets contain definitions and formulas, measurement exercises, and inquiry exercises that ask students to make predictions about the behavior of the roller coaster, ball loop, or inclined planes, then to test those predictions and revise their theories as necessary. The calculations worksheets guide students through data collection and recording, simple error analysis, and data display in tables or graphs. Most of these exercises require the use of algebra and trigonometry. The appendices provide conversion charts, hints for using measurement tools, glossaries of vocabulary and formulas, and sample data charts. Bibliographic references and suggested videos and software are also provided. (Author/LCT) ENC-012237

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LEGO DACTA Early Science & Technology Series

Early Simple Machines Set

Grades K-2
1994
Author: Floyd Flack, Linda Tammi

Ordering Information:
LEGO dacta
55 Main Street, Suite 5100
Enfield, CT 06460
Fax: (860) 429-2569
Toll-free: (800) 510-5773
http://www.lego.com/dacta/

$83.50 per set
Order # 9651-ENC
Note: Includes 71 DUPLO-sized pieces, 8 activity cards, and storage bin.

$21.00 per activity pack
Order # 9661-enc
Note: Includes teacher's guide and 11 activity cards.

Standards: Science Framework for California Public Schools (1990); New York State Curriculum, Instruction, and Assessment Framework for Mathematics, Science and Technology (Draft, 1994); Texas Science Framework

Students use the LEGO building blocks in this kit to construct a variety of simple machines, learning science process skills as they do so. The kit contains a teacher's guide, activity cards, and 71 oversized (DUPLO) pieces including gears, pulleys, wheels, axles, and handles. The teacher's guide provides six thematic lesson plans designed to help students relate simple machines to the real world. For example, one activity presents students with a situation in which two children want to know if it is windy enough to fly their new kites. Students are invited to invent a device to solve this problem. Other activities call students' attention to structures around the home and on the playground that use gears, pulleys, and wheels. Each lesson refers to a colorful activity card that presents the situation. The teacher's guide also contains a glossary, background information, questions and and answers, and extension activities. The activity cards are divided into four sets. The Green Exploration cards introduce the LEGO pieces and how they are used. Yellow Knowledge cards create a context for building by suggesting a theme for the simple machine concept under investigation. Blue Practice cards show students how to build simple models, and the Red Invention cards present an open-ended problem for children to solve. (Author/LCT)
ENC-012292

The Factory Deluxe: Strategies in Prob

Grades 4-8
1998
Author: Paul Kronmeyer, Jennabeth Bogard, Jennifer Simon, Joe Summerhays, John Mullaney, Frank Migliorelli, Karen Schlossberg

Ordering Information:
Sunburst Communications, Inc.
101 Castleton Street
PO Box 100
Pleasantville, NY 10570
Telephone: (914) 747-3310
Fax: (914) 747-4109
Toll-free: (800) 32[illegible]-7511
service@nysunburst.com
http://www.sunburstonline.com/

$89.95 per software package (Macintosh/Windows hybrid) or 5 lab pack

System requirements:
Macintosh: 68040 or better; 25 mHz; System 7.0 or higher; 8MB RAM; 640x480 monitor with 256 colors; 4x CD-ROM

Windows: Windows 3.1 or 95; 486 or better; 66 mHz; 8MB RAM; 640x480 monitor with 256 colors; 4x CD-ROM

The five factory-based activities on this CD-ROM are designed to help students expand their problem-solving strategies in geometry, sequencing, and spatial sense. Players learn how to use three types of machines in an assembly line setting: one that places punch marks and stripes on a geometric shape, one that cuts away part of a shape, and one that rotates a shape. In the activities, individual students experiment with researching, designing, and building products using different combinations of the machines. Then, in the shipping phase of the program, students use spatial ability to place orders in the properly shaped crate. In the delivery phase, students practice skills with area formulas, estimation, and computation as they play a strategy game to be the first to deliver their product. A special feature of the software is a journal option that allows students to save pictures of selected products and to record observations. Teachers can customize the software to meet student needs and keep records to chart student progress. Included with the software is a teacher's guide with detailed information about the program and overviews of the activities. (Author/JRS)
ENC-011765

Favorite Problems

Grades 5–7
1982
Author: Dale Seymour; illustrators, Bob Larsen, Rob Browne, Sharon Harker

Ordering Information:
Cuisenaire Dale Seymour Publications
10 Bank Street
PO Box 5026
White Plains, NY 10602-5026
Fax: (914) 328-5487
Toll-free: (800) 872-1100
http://www.awl.com/dsp/

Students in grades 5–7 can use this collection of classical problem sets to help develop problem-solving skills. Each of the 16 sets contains three related problems: a warm-up problem, the main problem (also presented as an illustrated poster), and an extension problem. An example of a problem set is the Frame Game, in which students count the number of different rectangles in a picture, find the number of different triangles in a six-pointed star and, in the extension, discover a rule for finding the number of different rectangles possible in a

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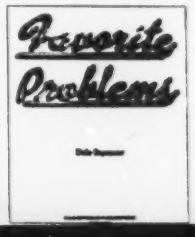


$32.00 per kit
Order # EN501-01231

$14.95 per book
Order # EN501-01234

$22.50 per poster set
Order # EN501-01232

square grid. In other problems, students count handshakes, form shapes using five squares with common edges, and find even numbers as sums of two prime numbers. Included in the collection is a section on the technique of teaching a discovery lesson, plus general suggestions for teaching problem solving. Each problem appears on a reproducible worksheet, with detailed teaching suggestions and solutions on the reverse side. The 16 poster problems are available in a spiral-bound, calendar-style format with colorful illustrations such as dancing dice and a Pascal Triangle dart board. Most of the solutions require only the use of basic arithmetic, although they may be solved using some algebra or geometry. The problems may be presented in any order and are suitable for in-class or homework assignments. (Author/JRS) ENC-011416

Super Problems

Grades 7-9
1982
Author: Lyle Fisher, Bob Larsen, Rob Browne, Sharon Harker

Ordering Information:
Cuisenaire Dale Seymour Publications
10 Bank Street
PO Box 5026
White Plains, NY 10602-5026
Fax: (914) 328-5487
Toll-free: (800) 872-1100
http://www.awl.com/dsp/

$32.00 per kit
Order # EN501-01241

$22.50 per poster set
Order # EN501-01242

$14.95 per book
Order # EN501-01244

As with the kit described above, this collection of problem sets is designed to develop problem-solving skills. Each set contains a warm-up problem, a main problem (also presented as an illustrated poster), and an extension problem. An example of a problem set is the Card Shark. In this set, the warm-up problem requires students to use tree diagrams to find the probability of drawing at least one ace when drawing two cards from a deck, while the main problem asks for the probability of guessing incorrectly five times in a card game. In the extension, students explore the probability of winning a raffle. Each problem in the problem book is on a reproducible worksheet with detailed teaching suggestions and solutions on the reverse side. The problem book also contains background ideas for teaching problem solving. The poster problems come in a spiral-bound, calendar-style format with colorful illustrations. Problem sets are arranged in general order of difficulty, but may be presented in any order. Most solutions require only the use of basic arithmetic, but problems may also be solved using algebra or geometry. Among the topics investigated are the Fibonacci numbers, binary numbers, and simple equations. (Author/JRS) ENC-011447

Logic Algebra Problems

Grades 9-12
1990
Author: Wade H. Sherard III; illustrator, Rachel Gage

Ordering Information:
Cuisenaire Dale Seymour Publications
10 Bank Street
PO Box 5026
White Plains, NY 10602-5026
Fax: (914) 328-5487
Toll-free: (800) 872-1100
http://www.awl.com/dsp/

$10.50 per book
Order # EN501-21103

Standards: NCTM Curriculum and Evaluation Standards (1989)

The 50 number puzzles in this book are designed to provide experiences in problem solving and thinking skills for high school students who have a background in algebra. Each puzzle consists of a sequence of 10 clues about an unknown number, and students use deductive reasoning to discover the answer using the fewest clues possible. To solve the puzzles, students must know some basic definitions and properties from number theory and numeration and some techniques from beginning and intermediate algebra; the primary emphasis, however, is on problem-solving strategies and thinking skills. The book's introduction contains background information about problem solving and the mathematics involved in the puzzles, as well as sample puzzles and suggested solutions. Blackline masters and solutions for all the puzzles are included. Each puzzle is illustrated with an amusing drawing. (Author/JRS) ENC-011448

Logic Geometry Problems

Grades 9-12
1993
Author: Wade H. Sherard III; illustrator, Rachel Gage

Ordering Information:
Cuisenaire Dale Seymour Publications
10 Bank Street
PO Box 5026
White Plains, NY 10602-5026
Fax: (914) 328-5487
Toll-free: (800) 872-1100
http://www.awl.com/dsp/

$10.50 per book
Order # EN501-21211

Standards: NCTM Curriculum and Evaluation Standards (1989)

This book, part of the series described above, is a collection of 50 geometric shape puzzles designed to promote problem solving and thinking skills for high school students who are familiar with geometry. Each puzzle consists of a sequence of 10 clues about an unknown convex polygon. To solve the puzzles, students must know the definitions and properties of various convex polygons, from triangles to dodecagons, as well as some basic algebra skills. As with the book described above, the primary emphasis is on problem-solving strategies and critical thinking. Background information, sample puzzles, and suggested solutions are available, and all puzzles include blackline masters and solutions. (Author/JRS) ENC-011453

Logic Number Problems

Grades 7-12
1987
Author: Wade H. Sherard III; illustrations, Rachel Gage

Ordering Information:
Cuisenaire Dale Seymour Publications
10 Bank Street
PO Box 5026
White Plains, NY 10602-5026
Fax: (914) 328-5487
Toll-free: (800) 872-1100
http://www.awl.com/dsp/

$10.95 per book
Order # EN501-01802

Standards: NCTM Curriculum and Evaluation Standards (1989)

Part of the series described on the preceding page, this collection of 50 number puzzles provides students with experiences in problem solving and thinking skills. The 10 clues given with each puzzle describe an unknown number that students must discover using deductive reasoning. To solve the puzzles, students need only some basic definitions and properties from number theory and numeration. Primary emphasis is on problem-solving strategies and thinking skills. The puzzles are illustrated with Sherlock Holmes-type drawings. (Author/JRS) ENC-011375

GEMS Series

Group Solutions, Too! More Cooperative Activities for Grades K-4 Teacher's Guide

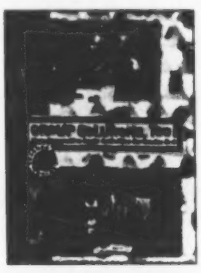
Grades K-4
1997
Author: Jan M. Goodman with Jaine Kopp

Ordering Information:
University of California, Berkeley
GEMS
Lawrence Hall of Science #5200
Berkeley, CA 94720-5200
Telephone: (510) 642-7771
Fax: (510) 643-0309
http://www.lhs.berkeley.edu/

$21.00 per book

Standards: NCTM Curriculum and Evaluation Standards (1989)

The 70 cooperative problem-solving activities in this teacher activity guide challenge students to reason, make deductions, and form conclusions. The activities often have a geometric focus and are intended to develop skills such as observation, classification, sequencing, and communication. In each activity, groups of four students work together. Each student receives a clue to a problem and shares the information with the other group members; the solution can only be found by logically connecting all the clues. In an example, pictures of six different planets are given to the group along with these clues: the planet is round; the planet is big; the planet has more than two rings; and the planet has less than four spots. Students use elimination to find the planet that matches all the clues. The guide includes lesson plans, background information, assessment strategies, and extensions. Also found are source lists for suggested materials, literature connections, and blackline masters for all the activities. (Author/DEB/JRS) ENC-011642



MathZones Series, Level A

Games for Number Sense

Grades 1, 2
1998
Author: Jane McCabe, Christine Losq

Ordering Information:
Great Source Education Group
Attn: Order Processing
181 Ballardvale Street
Wilmington, MA 01887
Telephone: (508) 661-1511
Fax: (800) 289-3994
Toll-free: (800) 289-4490
http://www.greatsource.com/

$19.95 per teacher's guide
Order # C3-044445

Standards: NCTM Curriculum and Evaluation Standards (1989)

This resource book is part of the MathZones series, which presents project-based learning activities that help students make sense of mathematics through hands-on experiences with manipulatives, through literature-based problem solving, and through journaling. The book assumes that students learn from one another and requires them to work in pairs or small groups to complete activities and to present their solution strategies. The lessons in this book use games to develop number meanings and number sense, to teach our numeration system, and to help students determine how numbers are used in real-world relationships. Occasional literature-based lessons provide students with opportunities to connect new learning with prior knowledge. Throughout the resource book, students are asked to explain, orally and in writing, their ideas about operations on numbers. In a sample lesson, students use domino cards for a two-player game. One player is assigned the number 5 and the other, 10. Each player turns over a card, adds the numbers together, and then determines whose number (5 or 10) is closest to the sum. After tallying who was closest for each event, the students discuss whether the game is fair and whether they should change the rules to make the game more fair. Each lesson lists needed materials, objectives, and ideas for starting and closing the lesson. Also included are suggestions for journal writing, teaching tips, discussion questions, suggestions for extension activities, and/or ideas for informal assessment. Activity sets are accompanied by actual student responses to the activities and/or samples of student work. This book provides reproducible blackline masters and a bibliography of compatible literature materials. (Author/LDR) ENC-009708

BEST COPY AVAILABLE

Networking Projects

http://www.glenbrook.k12.il.us/gbsmat/glazer/network.html

Grades 7-12

Author: Evan Glazer
Publisher: Northfield Township High School District 225

High school mathematics teacher Evan Glazer maintains this Web site of student projects ready for classroom use. Each project begins with a problem-solving scenario and goes on to provide a detailed list of requirements for carrying out the project and making the final report. Links to needed real data are given, as well as links to supplementary lessons on how to program calculators to do the required statistical operations. Problem contexts range from investigating stock market options to converting money to different currencies for use on a vacation. A sample activity, Chopping Broccoli, examines how fractals relate to the idea of similarity. An illustration shows the iterations a square can go through as it is transformed into a more complicated figure. After viewing further examples in geometry and in nature, students are asked to define iteration and, finally, to explain how chopping broccoli relates to similarity and fractals. A class handout is provided and links are given to other related sites. Winner, ENC Digital Dozen, May 1998. (Author/JRS/TAH) ENC-011990

Set Enterprises Home Page

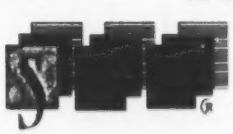
http://setgame.com/

Grades 3-12

Author: SET game developed by Marsha Falco; home page design & upkeep by Llewellyn Falco
Publisher: Set Enterprises, Inc.

System requirements: Tutorial requires Java-enabled browser (may require 5 minutes or more to load applet depending on connection speed and network traffic).

The Java tutorial on this award-winning Web site explains how to play a card game designed to engage the player's whole brain in a logical, spatial thinking activity. The deck for the basic game consists of cards with one to three symbols of a certain shape (squiggle, oval, or diamond), in one of three colors (red, green or purple). The play of the card game involves determining which three cards from a display of 20 will form a set in which each of three attributes (color, shape, and number) are either all the same or all different. The player with the most sets wins. Also found at this site is an explanation of the mathematics behind the game, a learn-to-play page, and the puzzle of the day. Available to download is a Shareware version of the game and a math workbook. Abstracted 11/98. (Author/JRS) ENC-013513



Shack's Math Problems

http://www.thewizardofodds.com/math/

Grade 9 and up

Author: Michael Shackleford
Publisher: Charm Net, Inc.

This Web site provides more than 80 math and logic problems that apply concepts from algebra, geometry, probability, statistics, and calculus. Also offered on the site are problems that are mathematical paradoxes and a category for unsolved problems. There are four marked levels of problem difficulty ranging from moderate through very hard. For example, a level-three problem reads: "One morning it starts to snow at a constant rate. Later, at 6:00 am, a snow plow sets out to clear a straight street. The plow can remove a fixed volume of snow per unit time; in other words, its speed is inversely proportional to the depth of the snow. If the plow covers twice as much distance in the first hour as the second hour, what time did it start snowing?" A mathematical paradox problem states: "You are given one dollar. You are told that your dollar will double for every time you toss a coin and it lands on heads. The first time you toss a tails the game is over and you keep what you have. For example if you toss three heads and then tails you would get one dollar times two times two times two, or eight dollars. What is the expected return of this game?" All problems provide an answer and many also supply an explanation of the solution. Winner, ENC Digital Dozen, September 1997. (Author/LDR) ENC-010769

Mathmania

http://www.csr.UVic.CA/~mmania/

Grade 4 and up

Author: Day Kirby; brought to you by the Mathmania Society
Publisher: University of Victoria, Department of Computer Science

Funding: British Columbia Ministry of Employment and Investment; Partners in Science Awareness Program

Students, teachers, and the general public are invited to explore mathematical frontiers using the online resources at this Web site. Focusing on newer areas of mathematics, this site offers an unsolved problem, along with explanatory materials (both textual and visual) in knot theory, graph theory, sorting networks, and finite state machines. The explanatory materials present the following aspects of the problem under consideration: a story that informally illustrates the concept, activities and real-world applications that motivate inquiry, a tutorial that takes the user from basic definitions right up to the open problems, and curriculum connections for

teachers. For example, the basic problem in knot theory is introduced through a story of space rollercoasters. Activities include making knots with string, with paper and pencil, with people, and then with sticks, noting which knots are identical and which can be untangled. An application presented under this topic involves the relationship of knots to DNA molecules. The tutorial takes the user through four levels, from the mathematical definition of a knot to the bases of the unsolved problem. Mathematical concepts used to describe knots include polynomials, group theory, and topology. Connections to the curriculum are included for concepts considered accessible to students of all ages, along with related activites field-tested in elementary classrooms. This site popularizes the efforts of Paul Erdos, a mathematician who posed open but unsolved problems to students. Verified solutions are posted to the site and, in some cases, a prize is awarded to young students and amateurs for correct answers. Students and mathematicians are able to communicate and present their research efforts. Winner, ENC Digital Dozen, May 1997. (LDR/TAH) ENC-009480

MathsNet

http://www.anglia.co.uk/education/mathsnet/index.html

Grades 6-12

Author: Brian Dye
Publisher: Anglia Multimedia

Created by Bryan Dye, the Head of Mathematics at a high school in Norwich, United Kingdom, this award-winning Web site aims to provide ideas for making math interesting and relevant for both high school teachers and students. One of the topics covered on this site is Aerobi-graphs, in which students use their bodies to animate concepts in graphing linear, quadratic, and trigonometric functions. The site also contains information about popular brands of graphing calculators. The alphabetical menu and search features allow for easy access to information that includes daily math puzzles, a short summary of the mathematics of fractals, and an online diary written by a teacher involved in England's mathematics reform movement. Also available at this site are animations illustrating the use of Logo, information on creating a spreadsheet and on graphing functions with transformations, and links to additional mathematical sites. Winner, ENC Digital Dozen, January 1998. (Author/JRS) ENC-011456

Problem of the Week Homepage

http://www.wits.ac.za/ssproule/pow.htm

Grade K and up

Author: Stephen L. Sproule
Publisher: University of the Witwatersrand

This page contains links to Web sites that offer a selection of regularly updated mathematics problems for students of all grade levels. The links are divided into four levels: elementary or primary, middle grade, high school, and advanced mathematics (including Advanced Placement topics). At each level, an annotated list of Web sites provides information on the availability of solutions to problems, access to problem archives, and an appraisal of the educational value and the quality of the site. Several of the sites offer a contest for students in which they submit an answer and either win a prize or get their name printed in a list of people who solved the problem. A sample link found at this site is the MATHCOUNTS Problem of the Week, which provides middle school students with a weekly problem focused on a current newsworthy event. Abstracted 2/99. (Author/JRS) ENC-013752

Seeing and Thinking Mathematically in the Middle Grades

Chance Encounters: A Probability Laboratory

Grades 4-7
1995
Author: George Brackett, Arny Brodesky, Glenn Kleinman

Publisher: Education Development Center, Inc.

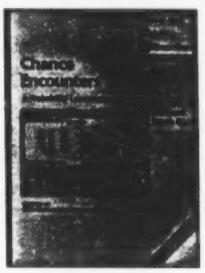
Ordering Information:
Heinemann Educational Books, Inc.
361 Hanover Street
Portsmouth, NH 03801-3912
Telephone: (603) 431-7894
Fax: (800) 847-0938
Toll-free: (800) 541-2086
custserv@heinemann.com
http://www.heinemann.com/

$39.50 per package
Order # 08352-ENC

Funding: National Science Foundation

System requirements:
Macintosh: all but Mac Plus, Mac Classic, or Powerbook 100; System 7.0 or above required.

The activities in this software package, designed to supplement *Chance Encounters: Probability in Games and Simulations*, allow students to test, revise, and design games and simulations. The software extends students' investigations in several ways. Experiments with very large numbers of trials (up to 30,000 spins) can be conducted quickly. It is easy for students to create and experiment with game pieces that have unequal probabilities, such as a loaded die. Experimental results are displayed as percentages, pie charts, and bar graphs as well as outcome counts. Students can use the software to explore patterns of results with varying numbers of trials or different theoretical probabilities. The program consists of three different labs: in Game Piece Lab, students focus on coins, number cubes, and spinners; in Cover-Up Game Lab, students investigate various spinners; and in Game Fairness Lab, students analyze results to determine whether games are fair. The software user's guide provides reproducible blackline masters that describe the investigations in each lab. (Author/LDR)
ENC-008515



$99.95 per software package or 5 lab pack
Order # 4004HG (DOS) or
Order # 6532HG (Mac)
Note: Available in Spanish on 3.5" or 5.25" disk.

System requirements:
Macintosh: Plus with an 800 K drive; 1 MB RAM; System 6.07 or higher; color monitor is recommended.

DOS: IBM/Tandy 1000 version or compatible computer; color monitor and color graphics adapter; EGA or VGA recommended; DOS 3.3 or higher; mouse is optional.

The Geometric SuperSUPPOSER

Grades 6-12
1993
Author: Judah L. Schwartz and Michal Yerushalmy

Ordering Information:
Sunburst Communications, Inc.
101 Castleton Street
PO Box 100
Pleasantville, NY 10570
Telephone: (914) 747-3310
Fax: (914) 747-4109
Toll-free: (800) 321-7511
service@nysunburst.com
http://www.sunburstonline.com/

Students can use this software package to draw, study, explore, construct, and solve geometry problems. Using the Shape menu, students can generate a random shape or create a shape that then serves as the basis for draw operations, measurements, and other manipulative operations. The Draw menu enables a user to make constructions (for example, lines, segments, extensions, perpendiculars, or bisectors) on the basic shape selected from the Shape menu. The user can also translate, rotate, reflect, and invert the shape. The Label menu contains features for subdividing, labeling intersections, generating points, and defining and automatically labeling points. Using the Measure menu, students can measure various components of their construction, including angles, lengths, and areas. The Repeat menu enables the user to repeat the constructions and measurements performed on a previous shape on a new shape of the same general category. The software has added features that make the program easier to use than an earlier version, *The Geometric Supposer*. To help students collect data and make generalizations, the software utilizes windows to display the most recent constructions on the same primitive shape and contains a specially devised Analyze window. This is the geometer's spreadsheet tool that lets students conjecture using data from the present and previous cases. It allows and encourages the asking of What if? questions by permitting users to see the results of current measures on previous shapes. The software also adds a full complement of transformations, allows users to copy angles, allows users to do a wide assortment of Locus problems, and displays a script listing all the elements of a construction. A function feature allows students to define any set of constructions that they may then execute on a given shape; functions may be saved. The teacher's guide describes each menu at length and provides a tutorial for working with the software, plus general information and specific suggested activities for using the software in the classroom. The guide discusses how to help students begin working with the software, questioning and discussion strategies, teaching modes (single computer, multiple computers, or group projects), ideas about geometric shapes, thinking skills, and planning units. It also includes eight inquiry problems, including the technical, pedagogical, and mathematical details needed to carry out the activity with students. Activity pages include the goal of the problem, instructions related to accomplishing the tasks with the computer, and suggestions for organizing the data and formulating conjectures. Software is available in English or Spanish. (AM/RMK)
ENC-013545

CBL Exploration Series

Explorations in Algebra for the TI-82 and the TI-83

Grade 10 and up
1996

Ordering Information:
Meridian Creative Group, Inc.
5178 Station Road
Erie, PA 16510-4636
Telephone: (814) 898-2612
Fax: (814) 898-0683
Toll-free: (800) 695-9427
sales@meridiancg.com
http://www.meridiancg.com/

$19.95 per text/disk set (DOS)
Note: Specify Macintosh or PC format.

System requirements:
CBL unit (power adapter AC-9201 recommended); TI-82 or TI-83 graphing calculator; Vernier equipment [CBL Ultrasonic Motion Detector (MD-CBL); Student Force Sensor (SFS-DIN); Magnetic Field Sensor (MG-DIN); Microphone/amplifier (MCA-U)] and CBL DIN adapter; TI graph link from Texas Instruments to download software from the supplied disk to the calculator. No computer specifications available.

This workbook, containing 15 experiments, describes and illustrates how to collect and analyze physical data using a Texas Instruments Calculator-Based Laboratory System (CBL) and a TI-82 or TI-83 graphing calculator. Each exploration begins with a general introduction of the experiment, followed by several pages containing specific details regarding equipment, set up procedures, and instructions necessary for performing the experiment. Each experiment requires recording results, analyzing collected data, and writing conclusions. Many explorations have extended experiments that allow for further investigation. For example, one experiment uses the temperature probe to record the temperatures over a 23 hour period. Then the recorded temperatures are used to create a scatter plot. This plot is used to explore concepts such as high temperature, temperature at two a.m., and when the temperature remained constant during consecutive time periods. Mathematical functions explored include those that form linear, quadratic, exponential, or hyperbolic graphs. The probes and/or sensors required in the explorations are an ultrasonic motion detector, a microphone amplifier, a temperature probe, a student force sensor, a light probe, and a pressure sensor. It is also possible to complete experiments by using sample data provided for each experiment. Programs required for each experiment are provided on an accompanying DOS computer disk. TI GRAPH LINK must be used to download the programs into the graphing calculator. (Author/LDR) ENC-007049

Data Explorer

Grades 4-8
1998
Author: Lois Edwards Educational Design, Information Technology Design Associates (ITDA), Bob Eyestone, Scott McSpadden, Neal Vaughn, Eric Hahn, Tony Hertzel

Ordering Information:
Sunburst Communications, Inc.
101 Castleton Street
PO Box 100
Pleasantville, NY 10570
Telephone: (914) 747-3310
Fax: (914) 747-4109
Toll-free: (800) 321-7511
service@nysunburst.com
http://www.sunburstonline.com/

$89.95 per CD-ROM package or 5 CD-ROM lab pack
Note: Please contact vendor for further information.

System requirements:
Macintosh: 68030 or better processor; 8MB RAM; 4MB free hard drive space; System 7.0 or later; 256-color monitor with 640x480 resolution; 2x CD-ROM drive.

Windows: IBM or PC; 486 DX2 with 66 MHz or better; 8MB RAM; 4MB free hard drive space; Windows 3.1, Windows 95 or higher; SVGA graphics, sound card; 256-color monitor with 640x480 resolution; 2x CD-ROM drive; mouse

This CD-ROM, designed for grades 4 to 8, allows students to create and administer surveys as a form of data collection, and then analyze that data graphically and with basic statistical tools. The survey tool allows students to create multiple choice surveys that can then be administered online. As the survey is completed, results are stored in a spreadsheet which can be saved for analysis. The data analysis section allows students to explore data from their surveys or from other sources, such as the examples included on the CD-ROM. Students can analyze interval, numerical, or categorical data using many types of graphs, including scatter plots, box plots, pie charts, histograms, and stem and leaf plots. *Data Explorer* will also calculate basic column statistics for numerical data. Each time a graph is produced, a menu specific to that type of graph allows students to do further explorations. For instance, on the scatter plot, students have the option of including a least squares fitted line or lines having formulas entered by the students. A notebook feature allows students to record observations as they look at a graph, spreadsheet, or survey. The teacher's guide includes a detailed guided tour of all of the features of the software, as well as a section on teaching data analysis that provides suggestions of various activities that can be implemented as a whole class or in small groups. A reference section gives brief notes on operating data explorer and a bibliography of instructional resources related to data analysis. (Author/RMK) ENC-013370

Calculator-Based Laboratory (CBL) System

Grade 7 and up
1994

Ordering Information:
Texas Instruments, Inc.
Customer Relations
M/S 3962
7839 Churchill Way
Dallas, TX 75251
Telephone: (972) 917-6335
Fax: (972) 917-7103
Toll-free: (800) 842-2737
ti-cares@ti.com
http://www.ti.com/

$250.00 per CBL unit
Note: US Suggested Retail Price. Call 1-800-TI CARES for vendor referral and pricing (TI indicates that dealers set prices).

Standards: NCTM Curriculum and Evaluation Standards (1989)

Equipment: Requires 4 AA batteries; TI-82, TI-85, or TI-85/CBL calculator.

This hand-held, calculator-based, data collection system is designed for math and science students in high school and college. A Texas Instruments TI-82 or TI-85 graphics calculator is used to set up the data collection parameters that are communicated to the CBL. Students can then disconnect the CBL, allowing it to act as a stand alone data collection device. Once the data is collected, students can reconnect the CBL to the calculator to retrieve and analyze data. The CBL can also be left connected during data collection; can be used as a multimeter, for measuring voltage, resistance, motion data and more as a stand-alone device; and can measure internal battery voltage. Students can gather a variety of real world data using probes, three of that are included: temperature, light, and voltage. An optional adapter (not included) provides compatibility with many other probes, making it possible to measure force, sound, pH, and other characteristics and phenomena. The CBL computes first and second derivatives on collected data; computes minimum, maximum, mean, and standard deviation statistics values on collected data; and records absolute or relative time as data is collected. Data smoothing algorithms are built in. Data can be collected on up to five channels simultaneously, and can be collected at rates of up to 10,000 points per second for up to a total of 512 points per channel. Users can collect data real time at rates of up to 14 points per second with the TI-82 and 12 points per second with the TI-85. Features of the CBL include a liquid crystal display that shows CBL status and collected data, a trigger that manually starts data collection from the CBL unit, a channel view that allows monitoring of data being collected on active channels, and an AC adapter port. Unit comes with an impact resistant carrying and storage case; a workbook of classroom experiments for physics, math, and chemistry; and a guidebook. (Author/MPN) ENC-002935

Vernier Probeware
Universal Lab Interface Package

Grades 7-12
1993
Author: Transpacific Computer, Dickinson College, and Tufts University

Ordering Information:
Vernier Software
8565 SW Beaverton-Hillsdale Highway
Portland, OR 97225-2429
Telephone: (503) 297-5317
Fax: (503) 297-1760
http://www.vernier.com/

$59.00 per Logger Pro software (specify platform)
Order # LP-ENC

$299.00 per ULI unit
Order # ULI-ENC
Note: Contact publisher for ordering specifcations.

System requirements:
Macintosh: Plus or newer with System 6 or higher.

DOS: IBM or compatible computer; 16 MHz 286 or higher (386/486 recommended); 1MB RAM; hard disk; VGA or SVGA monitor and graphics card; DOS 3.3 or higher; mouse; unused serial port.

This hardware and software package allows the communication between a microcomputer and a variety of sensor probes such as motion detectors, force sensors, radiation monitors, pH probes, temperature probes, pressure and light sensors, and microphones. The Universal Lab Interface (ULI) reads values from the sensors and communicates with the computer via the serial port. The software allows the computer to analyze and display data and graphs as the experiment takes place. Data can be collected at rates up to 11,000 readings per second. User's manuals and instruction booklets are included with the ULI. (Author/DEB) ENC-002939

Introduction to Airplane Design

Grades 8-12
1996
Author: Bryan Holt & Clayton Holt

Ordering Information:
Seeds Software
PO Box 30157
Seattle, WA 98103-5320
Telephone: (206) 782-0914
Fax: (206) 782-0918
science@seeds2lrn.com
http://www.Seeds2LRN.com/

This software package, designed for grades 8 to 12, introduces students to basic aerodynamics through simulations and hands-on activities. The software comprises two diskettes. The first disc contains simulations and tutorials that present the theoretical concepts of flight, specifically how gravity and lift, thrust and drag, and force and balance apply to the design of each component of an airplane. In a sample tutorial on lift, students explore lift by manipulating an animated simulation of airflow over an airfoil. Each tutorial contains an explanation text box that provides additional informa-

$97.00 per software package (specify Windows or Macintosh)
Order # AD1-ENC
Note: Site licenses are also available. Please contact vendor for further information.

System requirements:
Macintosh: 2.5 MB RAM; 3 MB disk space; System 6.0.5 or greater; grey scale or color monitor; Hypercard 2.x; ClarisWorks.

tion. The tutorial section also includes a diagram of the components of an airplane and a glossary of scientific terms. After completing the tutorials, students turn to the Real Glider section where they apply their understandings of flight to the design of an aircraft. The Real Glider contains simulations that enable students to manipulate variables such as wing dimensions, horizontal and vertical stabilizer, and fuselage dimensions. The software then calculates the final total mass and wing load, and constructs an image of the students' design, which they can view from the top and sides. A problem message alerts students to errors in their design, and explains why their glider can't fly. The second disk contains instructions for 15 hands-on activities in which students build models of each functional part of airplane. For each activity, the disk provides a reproducible worksheet with a list of required materials, an illustrated procedure, and open ended questions. In a sample activity, students develop their understanding of wing load by designing and building a glider out of balsa wood. Upon completing the glider, they demonstrate how wing load affects airplane performance in laboratory activity in which students observe and record their glider's flight distance, loft time, speed, and glide ratio. Teacher notes, quizzes, and answer keys are provided. (Author/YK) ENC-013336

Interactive Physics Simulations

Grades 8-12
1996
Author: David Vasquez, Matt Walker, and John Minnerly

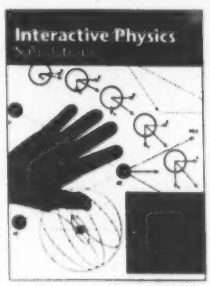
Ordering Information:
Scott Foresman Addison Wesley (SF-AW)
1 Jacob Way
Reading MA 01867
Fax: (800) 333-3328
Toll-free: (800) 552-2259
http://www.scottforesman.com/sfaw/

$43.56 per software package
Note: Specify Macintosh or Windows

This software provides 32 interactive simulations of physics principles along with student worksheets to accompany them. The simulations allow the students to manipulate variables and then run the simulations to observe the results in a very visual format. While the simulation is running, meters change as variables within the simulation change. Graphs of certain variables are drawn at the same time that the simulation is running. Students may also choose to track the motion in the simulation by having the figures freeze into position every 0.5 seconds. This allows students to actually take a ruler and measure the distance between moving objects at various times during the simulation. Simulations include a rocket chair in which the driver can wear a seat belt or not to demonstrate inertia. When not wearing his seat belt he is subject to flying into a brick wall. Levers are demonstrated by using two children hanging from chairs on a pole over a mud puddle. When the variables are not set properly they both fall in the mud. Students may choose to just manipulate the variables to see what happens under different situations or they may make use of the workbook pages that ask them to make predictions, set up specific circumstances and then test their predictions. The questions asked in the worksheets require the students to think about what they have seen in the simulations and explain the answers that they choose to give. There is one series of questions and activities for each simulation. The workbook also contains directions for operating the program and the answers to the worksheets. (Author/SSD) ENC-013243

System requirements:
Macintosh: 2MB RAM (4MB recommended); 3MB hard disk space; System 6.0.5 or later

Windows: 386 or better; 4MB RAM (8MB recommended); 6.5MB free hard disk space; 1.44MB; 3.5" disk drive; Windows 3.1 or later



Visual Physics

http://library.advanced.org/10170/

Grades 9-12

Author: designed by physics students at Cariboo Hill Secondary School
Publisher: Cariboo Hill Secondary School

System requirements:
Any browser that supports Java Applets, JavaScript, and Frames (e.g. Netscape 3, IE 3, or higher version); Modem speed of 14400 baud or faster; 80486DX or higher; 4MB RAM or more.

This Web site provides basic instruction in physics using manipulated animations. The animations feature physical principles such as force, work, and projectile motion, as well as electricity, kinematics, and momentum. In each animation the students may set the various parameters of the application and run the animation recording the resultant values. An online glossary is provided along with tutorials in selected subject areas. A question of the week is shown with the answer for the question of the previous week. Short biographies of physicists like Copernicus, Einstein, and the Curies are included. Links are supplied to other sites that explain physics principles using Java animations. Winner, ENC Digital Dozen, November 1997. (SSD) ENC-010906

BEST COPY AVAILABLE

Thinkin' Science Series

Thinkin' Science

Grades 1, 2
1997

Ordering Information:
Edmark Corporation
PO Box 97021
Redmond, WA 98073-9721
Fax: (425) 556-8430
Toll-free: (800) 691-2986
edmarkteam@edmark.com
http://www.edmark.com/

$59.95 per CD-ROM package (school version)

System requirements:
Macintosh: System 7.0.1 or higher; 68030 (25 MHz or faster recommended); 8MB RAM (16MB recommended for PowerPC); 13" 256-color monitor; 2x CD-ROM drive

Windows: Windows 3.1 or higher; 486 Pentium (33 MHz or faster recommended); hard drive with at least 5 MB RAM free; 8 MB RAM; Super VGA graphics, 640 x 480, 256 or more colors; 2x CD-ROM drive; sound card

This CD-ROM, developed for grades 1 and 2, is designed to help children develop observation skills and explore fundamental science concepts in physics, earth science, and life science. Students begin inside the Super Secret Science Station where a radar screen displays signals sent by the Science Scouts: Bobbie, Buddy, and Einstone. Students click on a signal to enter a learning environment and begin a science challenge activity. The five environments (Day and Night, the Mystery Cave, Animal Tracks, What Did You See?, and Physics Fun) each contain a series of progressively difficult activities. In Day and Night, students discover that the Earth spins on an axis and rotates once per day. Fun Physics contains simulated motion experiments in which beginning students solve challenges that involve balls of different weights andadjustable straight and curved ramps. Advanced students launch balls at moving targets and adjust the length of a pendulum to knock oranges out of a tree. Students learn about animals and seasons in What Did You See?, a memory game that helps students sharpen their observation, visual discrimination, and perception skills by recalling animals' locations in nature scenes. The tool bar provides hints about the animals' habitats. An additional game, Animal Tracks, shows students how to identify an animal's footprints by studying the number of toes, shape, pattern, and size of the foot. Beginning students are asked to identify one set of prints and the game progresses until students are interpreting multiple sets of prints and thinking about each animal's movements. In the fifth game, the Mystery Cave, students use deductive reasoning to identify an unknown object by using tools that gather data about the smell, texture, color, shape, and weight of the object. As students solve the science challenges, they are rewarded with printable treasures to color, such as animal masks, puzzles, and games. The CD-ROM also contains options that allow parents to customize the program for their children. These options include a slider bar to adjust the level of difficulty and a section that introduces the CD-ROM and provides ideas for doing science with children. (Author/LCT) ENC-012222

Thinkin' Science Series

Thinkin' Science Zap!

Grades 3-6
1998

Ordering Information:
Edmark Corporation
PO Box 97021
Redmond, WA 98073-9721
Fax: (425) 556-8430
Toll-free: (800) 691-2986
edmarkteam@edmark.com
http://www.edmark.com/

$59.95 per CD-ROM package (Mac/Windows; school edition)
Order # 802-0721
Note: Lab packs and site licensing available. Contact vendor for further information.

System requirements:
Macintosh: 68040 or PowerPC; 8MB RAM, 16 MB with PowerPC; System 7.0.1 or later; 13" 640x480 256-color monitor; 2x CD-ROM drive

Windows: 486, Pentium or better, 66 MHz or faster; 8 MB RAM; 5 MB RAM free; Windows 3.1or higher; 2x CD-ROM drive; sound card; SVGA 640x480 monitor with 256 colors

This CD-ROM provides a virtual laboratory where students can experiment with optics, sound, and electric circuits. The CD-ROM invites students to join rock stars Blaze, Riff, and Surge in a concert where students, acting as Guest Directors, control the light and sound system. However, lightning has just struck the theater and the control systems have gone haywire. Electrons are leaking from open circuits, and the light and sound systems also need repair. Students follow each character into his or her laboratory to learn how to fix the equipment and earn the components that they will use to repair the lightning damage. The Laser Light Lab features a virtual laser table where students reflect, refract, and absorb light by manipulating a variety of lenses, mirrors, filters, and barriers. In the SoundWave Studio, students see, hear, and control sound waves to make Boogiebots dance to a particular frequency or amplitude. In Surge's Electroloft, students tinker with batteries and light bulbs, wires and switches, and conductors and insulators to connect a variety of gadgets in series and parallel circuits. They also repair existing circuits by changing the battery terminals, locating short circuits, and removing nonconducting materials. Each laboratory features a Question & Answer tutorial mode as well as a free exploration mode. As students progress through the tutorials, they advance along a color-coded Grow Slide to more challenging problems. The Adult Options allow users to set the slide at a specific level for further practice. Additional science content information is provided through an electronic encyclopedia that contains over 200 articles written especially for children. Once students have collected their components, they proceed to the concert stage where they use what they have learned to create their own multimedia concert with colored lights, sound effects, and other electrical wizardry. (Author/LCT) ENC-013504

77

PhysicaElementa Collection

Velocity and Acceleration

Grades 8-12
1998

Ordering Information:
Intellectum Plus Inc.
130 Slater Street, Suite 750
Ottawa, ON K1P 6E2
Telephone: (613) 745-9490
Fax: (613) 745-1623
Toll-free: (877) 853-2768
education@intellectum.ca
http://www.intellectum.ca/

$79.00 per CD-ROM package (school version; Windows)
Note: Sold in packages of 1, 5, 10, 20, and 30 CD-ROM units. Contact publisher for additional ordering options.

Funding: National Research Council of Canada

System requirements:
Windows: 386, 486 or Pentium; Windows 3.1 or higher; 4MB RAM (8MB recommended); 1MB available hard disk space; VG or higher graphic card and monitor; 8-bit sound card and speakers; sound board; CD-ROM drive

Students explore speed, velocity, and acceleration through the more than 100 physics questions on this CD-ROM. The series comprises interactive tutorials with an emphasis on problem-solving skills. Each module introduces a concept with a narrated animation and then presents a set of problems that students solve by answering a series of multiple choice questions. In a sample problem, a boy starts to row a boat heading north; students are told his initial velocity relative to the water. Leading questions guide students through the main reasoning steps, from analyzing the problem context and its related variables, to reminding them of the formula for relative velocity. The program also helps users set up the calculations and verify the solution. As students begin to answer the questions, additional facts, relationships, and calculations are provided. After they have answered the questions, the software provides feedback, a review of what was covered, or a graphical or numerical representation of their progress and scores. Each student's progress is assessed using Fuzzy Logic and an Artificial Intelligence engine designed to track his or her progress and modify the questions according to each student's ability. For example, students who are having difficulty understanding a concept are automatically provided with additional questions designed to assist them in their problem area, whereas students who are having no difficulties may complete the module in fewer steps. Additional features include On Line References, which includes tutorials, animations, reference text, and tables as well as a note pad, a calculator, and a hint button. Another feature, Making Connections, contains life examples and funny stories that show students how physics affects their daily lives, such as the speeding tickets that are given when our instantaneous speed exceeds the average speed. A third feature, the Learning Route, provides a three-dimensional, hierarchical concept map that organizes the problems sequentially into a spiral. The Learning Route also provides a visual way for teachers to monitor each student's progress and enables them to print a report for each student. (Author/YK) ENC-013311

The Bungee Egg Challenge

Grades 8-12
1997
Author: developed by Bryan Holt & Clayton Holt

Ordering Information:
Seeds Software
PO Box 30157
Seattle, WA 98103-5320
Telephone: (206) 782-091
Fax: (206) 782-0918
science@seeds2lrn.com
http://www.Seeds2LRN.com/

$97.00 per software package
Order # BEC1-ENC (specify platform)
Note: Site licenses and lab packs are also available. Please contact vendor for further pricing information and system requirements.

This software package, designed for grades 8 to 12, provides computer simulations and laboratory activities that introduce students to the dynamics of energy, motion, and forces as they design a protective container for an egg. The software comprises two diskettes. The first disc contains a simulation and tutorials about how to design containers for an egg drop challenge. The tutorials demonstrate how to calculate free fall, elasticity, and support strength. The theory and design sections provide information on how impact, motion, elasticity, energy, and energy dissipation concepts are incorporated into the design of an egg carton. In a sample tutorial, students explore elasticity and damping by comparing different types of cords such as rubber, nylon, and rock climbing cords. An information window allows students to toggle between text and graphical explanations of related scientific principles. The program culminates in the Egg Drop Simulation Lab, where students manipulate such variables as egg position in the bottle, bottle drop height, and egg mass. The software calculates their results and shows how these variables affect velocity, momentum, and energy in addition to simulating the consequences of the egg drop experiment: survival intact versus a splattered egg. The second disk provides instructions for laboratory activities in which students participate in a real bungee egg challenge. Each activity includes a reproducible worksheet with a list of required materials, an illustrated procedure, and follow-up questions. Teacher notes with additional lab activities, quizzes, and answer keys are also provided. (Author/YK) ENC-013335

Science Court Series

Living Things

Grades 4-6
1998
Author: Tom Snyder, David Dockterman, Bob Thibeault, Eytan Bernet

Ordering Information:
Tom Snyder Productions, Inc.
80 Coolidge Hill Rd
Watertown, MA 02172-2817
Fax: (617) 926-6222
Toll-free: (800) 342-0236
http://www.teachtsp.com/

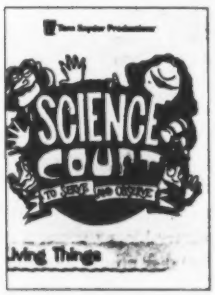
Science Court is a CD-ROM series that mixes courtroom drama, student activities, and humor to teach fundamental concepts of science and model good scientific practice to students. Each CD-ROM in the series requires two to three class periods to complete and is designed to promote teamwork, collaboration, and communication. In this CD, Jen Betters, a courtroom correspondent, leads students through a humorous courtroom trial in which

$59.95 per CD-ROM package (Windows/Macintosh)
Order # ENC-LIV
Note: Special pricing until August 1999 of $29.95. Please mark orders attn: Sandy.

System requirements:
Macintosh: LC 475 minimum; 68040 processor or higher; 7.1 or later; 8MB RAM; 640x480 256-color monitor

Windows: 486 or higher; Windows 3.1 or higher; 8MB RAM; sound card; 640x480 256-color montior

Walter Williamson, a poet who writes poems to memorialize dead pets, is charged with breach of contract for refusing to write poems about a chicken bone, brine shrimp eggs, and a leather wallet. The trial is divided into four parts that investigate the characteristics of life; how a process, such as making paper from trees can change a living thing into a nonliving thing; and what potential for life means. The verdict is presented in the fourth part of the trial. At the end of each part, students break into cooperative groups to answer discussion questions and to complete a related hands-on activity. In a sample activity, students hatch brine shrimp eggs to demonstrate how the potential for life places objects in the category of living things. The teacher's guide contains learning objectives, detailed lesson plans with instruction for using the CD-ROM, and reproducible worksheets as well as assessment materials and suggestions for extending the lesson. Also included is a poster that illustrates important ideas from the trial and suggests additional activities for classifying life. (Author/JRS) ENC-013386



$79.00 per CD-ROM set
Order # SCIMAX18CD-ENC
Note: Contact publisher about additional ordering options.

Standards: National Science Education Standards (December 1995).

System requirements:
Macintosh: System 7.1 or later; 8MB RAM; 256 color display; headphones or speakers; 2x-speed CD-ROM drive; need Adobe Acrobate reader to access PDF files of entry booklet and forms

Windows: 386SX/25MHz processor (486DX or higher recommended); Windows 3.1 or higher; DOS 3.1 or higher; 4MB RAM (8MB recommended); 2x-speed CD-ROM drive; 256 color display (16-bit color recommended); sound card (16-bit recommended); headphones or speakers

for each episode, and each level has a different solution and different resources to investigate. The program opens by introducing students to the Sleuth Extraordinaire, who details the mystery and guides students through the program. After viewing a video introduction, students enter a virtual science laboratory where they formulate a hypothesis by examining news stories, scientific articles, and photographs, as well as listening to expert interviews and testimony. They then gather data to support their hypotheses by using the more than 20 tools included in the program to conduct lab experiments and analyze test samples. For example, after a mysterious blob is found on the beach, students discover its composition by clicking on a gas chromatograph, a mass spectrometer, and a Geiger counter. Students can also weigh and measure objects, as well as calculate specific densities or solubilities. Other tools include a mass spectrometer, a microbiology laboratory, and a pH meter. Students also have access to maps and charts, an encyclopedia and a glossary, and a calculator and searchable database. As they conduct their investigations, students record their observations and data in an electronic notebook, then edit their reports and print them for the teacher to assess. The teacher's guide describes the program and the sleuth tools used in the episode and provides solutions to all mysteries, along with guidelines for teaching problem-based learning. The guide also contains blackline masters of student worksheets and suggestions for informal and authentic assessments. (Author/LCT) ENC-005144

Science Sleuths

Science Sleuths, Volume 1: The Mysteries of the Blob and The Exploding Lawnmowers

Grades 6-12
1995
Author: executive producer, D. Joseph Clark

Ordering Information:
Videodiscovery, Inc.
1700 Westlake Avenue North, Suite 600
Seattle, WA 98109-3012
Telephone: (206) 285-5400
Fax: (206) 285-9245
Toll-free: (800) 548-3472
http://www.videodiscovery.com/vdyweb

This CD-ROM and teacher's guide were developed for grades 6 to 12 as part of the Science Sleuths series of science mystery games. The Science Sleuths CD-ROM is a two-volume set featuring an integrated approach to science. Life, Earth, and physical science concepts are incorporated into real-life puzzles that allow students to develop critical-thinking and problem-solving skills as they evaluate information and identify relevant facts. This CD-ROM, Volume I, contains two episodes, The Mystery of the Blob and The Mystery of the Exploding Lawn Mowers. Six levels of play are available

BEST COPY AVAILABLE

Mathematics Contests: A Guide for Involving Students and Schools

Grades 9-12
1990
Author: Frederick O. Flener

Ordering Information:
National Council of Teachers of Mathematics, Inc.
1906 Association Drive
Drawer A
Reston, VA 20191-1593
Telephone: (703) 620-9840
Fax: (703) 476-2970
Toll-free: (800) 235-7566
orders@nctm.org
http://www.nctm.org/

$13.00 per book
Order # 407-ENC

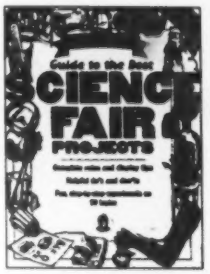
According to the author of this book, the primary purposes for mathematics contests are to have fun with mathematics and to tackle difficult problems not normally encountered during class. This book describes how students and teachers benefit from competitions and provides formats for competitions at the high school level. For each level, the book includes sample questions for two kinds of written competitions as well as for specialized competitions such as relay, calculator, estimation, multiple choice, and oral. Suggestions are also given for starting a mathematics contest and for coaching student participants. The author notes that faculty, administration, and the board of education must support mathematics competitions and that faculty must commit to helping with home meets. (Author/LDR) ENC-008455

Janice VanCleave's Guide to the Best Science Fair Projects

Grades 5-8
1997
Author: Janice VanCleave

Ordering Information:
John Wiley and Sons, Inc.
One Wiley Drive
Somerset, NJ 08875 1272
Telephone: (908) 469-4400
Fax: (908) 302-2300
Toll-free: (800) 225-5945
http://www.wiley.com/

$14.95 per book



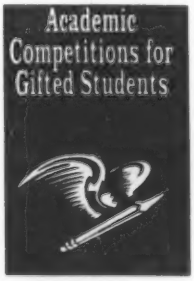
Designed to show students how to create, assemble, display, and present a science fair project, this book includes ideas for biology, Earth science, engineering, physical science, mathematics, and astronomy projects. Part I of the book outlines and explains the scientific method, topic and project research, and categories. It also provides a sample project and project report, discusses the display, and describes the oral presentation and the judge's evaluation. Part II features project research and ideas for planning and developing projects on 50 topics. These ideas are not intended to be complete projects, but rather to offer guidelines for developing the student's own science fair project. In one sample experiment, the student tries to determine what causes a solar eclipse by closing one eye and looking at a distant tree with the other. Holding a coin near and to the side of the open eye, the student moves the coin until it is directly in front of the eye, in this way representing the blocking of the sun's light by the moon. The book also gives a list of reference books, sources of scientific supplies, and a glossary. (Author/FEB) ENC-008847

Academic Competitions for Gifted Students: A Resource Book for Teachers and Parents

Grades K-12
1996
Author: Mary K. Tallent-Runnels, Ann C. Candler-Lotven

Ordering Information:
Corwin Press, Inc.
2455 Teller Road
Thousand Oaks, CA 91320
Telephone: (805) 499-9774
Toll-free: (800) 417-2466
order@corwinpress.com
http://www.corwinpress.com/

$24.95 per book
Order # DENC-61561



Teachers and parents can use this book to find out about many academic competitions and to find tips on how to use competitions in a beneficial manner with gifted children of all ages. Criteria are provided for selecting and/or implementing academic competitions in light of students' strengths and weaknesses. The book identifies and discusses ways to anticipate and avoid potential problems with competition and provides strategies for maximizing the benefits of competitions. Competitions are indexed by content area, grade level, and title. (Author/LDR) ENC-006276

Science Fairs, Ideas and Activities

Grades 7-12
1998

Ordering Information:
World Book Inc.
525 West Monroe Street, 20th floor
Chicago, IL 60661
Fax: (800) 433-9330
Toll-free: (800) 975-3250
edproducts@wbpublish.com
http://www.worldbook.com/

$15.00 per book (hardcover)
Order # 3700
Note: Price discounts for multiple copies are available. Contact the publisher for more information.

Useful to students, parents, and teachers alike, this resource book is designed to help students get the most out of their experience with a science fair. The book includes a section on how to select and present a topic, from what to expect to how to dress. Also included is a description of the scientific method and a checklist to review before the science fair. Ideas are presented by subject area and include space, machines, dynamic Earth, botany, and sounds. Each subject area begins with a list of questions meant to stimulate ideas about that subject. One activity is an exploration of wind direction that uses graph paper, cardboard, a compass, and a pencil to create a wind recorder. Full-color photos help illustrate the projects. (Author/RMK) ENC-013181

1998-1999 MATHCOUNTS School Handbook

Grades 7, 8
1998
Author: editor, G. Patrick Vennebush

Ordering Information:
Sports Awards Company
MATHCOUNTS Orders
4351 North Milwaukee Avenue
Chicago, IL 60641
Telephone: (773) 282-8060
Fax: (773) 282-3019
Toll-free: (800) 621-5803

1 handbook: **Free**
Note: Handbooks available free of charge from local and state MATHCOUNTS coordinators. For more information, contact the MATHCOUNTS Foundation at http://mathcounts.org/MCForms/Comments/Comments.html

This 1998-99 handbook is designed for schools, teams, and coaches participating in MATHCOUNTS, a nationwide program designed to stimulate student interest and achievement in mathematics. The book outlines how to develop a MATHCOUNTS program at a school and provides information on rules, competitions, and deadlines. The program, which considers the sharing of mathematical ideas by students an important component, is built around coaching sessions held once or twice a week for all interested students. A four-person school team is then chosen in January and participates in competitions at chapter and state levels, culminating in a national competition of the selected state teams. Each year, MATHCOUNTS designates a special topic designed to stimulate student interest in mathematics; the topic for 1998-99 is Investigation and Exploration. In support of this topic, the handbook offers background information about the development of classroom exploration methods and an explanation of the process for inquiry learning. Also found are descriptions of the four basic characteristics of a good inquiry problem: the problem must be realistic; the exploration needs to be complete; the situation and requirements must be unambiguous; and the problem must be solvable. The book includes two extended, open-ended activities using real-world situations, complete with teacher's guide, student guide, and fact sheet. Warm-up activity sets survey the grade level curriculum and multi-step problem sets challenge students to use their mathematical skills as they prepare for competition. The activities are also appropriate to supplement the regular curriculum. All answers are included, along with suggestions for appropriate problem-solving strategies for each problem. Several problems in each activity set are footnoted with ideas for connecting the problem to a real-world use of mathematics. A list of references is provided. (Author/JRS) ENC-013408

MATHCOUNTS Web site

MATHCOUNTS

http://mathcounts.org/

Grades 7, 8

The MATHCOUNTS Web site contains information about how to get involved in the program as well as a section with problem-solving tips, problems, activities, and a discussion on algebraic reasoning. For example, in the Problem of the Week section, one challenging problem describes the chemical make-up of a buckminsterfullerene (a.k.a. buckyball) and then asks students to calculate the number of bonds in the more recently discovered stickyball. Solutions involve spatial and logical reasoning, as well as determination and persistence. The site also contains an online store from which users may purchase MATHCOUNTS books and merchandise, such as collections of past problems and solutions, coaching information, and prizes. An online registration form and several forums for coaches, mathletes, and educators are provided. (Author/RMK) ENC-012556

internet resources

Welcome to the Math League: Building Student Interest and Confidence in Mathematics Through Solving Worthwhile Problems

http://www.mathleague.com/

Grades 4-12

Author: Steven R. Conrad, Daniel Flegler, Mark Motyka
Publisher: Math League Multimedia

The Math League sponsors contests and publishes books and computer software designed to stimulate interest in and promote confidence in mathematics for students. Their Web site provides information that will enable teachers, educators, and parents to bring challenging mathematics materials to students. It contains sample tests and problems from past contests as well as information on how to enroll a school in the contests. Also available are instructions for ordering Math League's educational software products and books. A section on the Homeschool Math League describes contests designed for homeschooled children. (Author/RMK) ENC-012664

CNBC Student Stock Tournament

http://sst.cnbc.com/

Grades 4-12

Author: CNBC; tournament director, Bill Griffeth

Publisher: CNBC

Designed for grade school and high school student investment clubs in the United States and Canada, this Web site encourages students to learn about the stock market and to improve their financial literacy. Students compete for nominal weekly prizes and a quarterly grand prize for their school. Winners in the tournament are those clubs that have the highest percentage increase in portfolio value. Weekly winners are posted on the site and highlighted on a special segment on CNBC Business News. The site discusses how the stock market works, what the ticker is, and how to buy in the futures market. A glossary defines investment terms, and a teacher section contains a practice module that teachers and parent advisors can use to create a practice stock portfolio. The site lists other Web resources on the stock market and offers practical information for competing in the tournament. Winner, ENC Digital Dozen, May 1998. (Author/JRS) ENC-011859

Science Hobbyist

http://www.eskimo.com/~billb/

Grades 7-12

Author: Bill Beaty
Publisher: Eskimo North, Inc.

Maintained by science enthusiast Bill Beaty, this Web site offers original content and Internet links to information about science education and homeschooling, science projects and museum exhibits, and misconceptions and "weird science." Visitors can find amateur science resources, electronics hobbyist projects, and science projects for kids. Organized according to level of difficulty, these projects range from blowing underwater antibubbles (simple) and drawing holograms by hand (medium difficulty) to building a home Van de Graff generator (advanced). Each project includes an illustrated procedure, scientific explanations, and links to related Web sites. (Author/LCT) ENC-012431

Science Talent Search

http://www.sciserv.org/stshome.htm

Grades 9-12

Author: Science Service
Publisher: Science Service

Funding: Intel Corporation

This Web site is the home page for the 1999 Science Talent Search, a competition that has been in effect since 1942 and has produced many winners that have gone on to become award-winning, internationally known scientists. Students are judged on their research ability, scientific originality, and creative thinking. Over the years, more than 114,000 students have submitted projects. Each entry includes a written description of the project and provides evidence of the student's creativity and interest in science. The 40 finalists participate in the final judging and share the $330,000 in scholarships. They travel to Washington, meet scientific and political leaders, and present their research to thousands of people. Links provide a listing of the semifinalists by state; each listing includes the students' names, city, address, school, and the title of their project. Other links provide the entry booklets and forms, a list of Science Talent Search Alumni, and a 1998-1999 Intel Science Talent Search Timeline that contains the deadlines, travel information, and prize amounts. Abstracted 01/99. (Author/JSR) ENC-013755

Virtual Science Fair

http://www.parkmaitland.org/sciencefair/index.html

Grades K-6

Author: Laura Cohn
Publisher: NetPassage, Inc.

The Park Maitland School in Maitland, Florida, developed this Web site to showcase a series of science fair projects and inventions produced by the students. The inventions, which are described and illustrated, include a page-turning machine, glow glasses, and a thumb protector. Written as scientific reports, the experiments address questions such as how do bananas ripen best and how does the switching of gears affect the performance of a bicycle. The projects presented in this site are examples of cross-curricular learning. These science fair projects and inventions were done as part of a science class and the Web sites were produced by the students while learning computer applications. The pages contain student-produced text; a photograph, drawing, or computer design chosen by the students; and a link to another related Web site. Winner, ENC Digital Dozen, September 1997. USA Today, Hot site, May 24-26, 1997. For other awards, see the full catalog record in ENC's Resource Finder. (SSD) ENC-010768

Dr. Internet

http://www.ipl.org/youth/DrInternet/

Grades 1-12

Author: Joseph Jones, Schelle Simcox, David S. Carter, Nettie Lagace, Michael McClennen, Sara Ryan
Publisher: School of Information, the University of Michigan
The Internet

Public Library (IPL) developed this Web site to help students explore science and math fun and facts on the Internet. The site provides ideas for science experiments and science fair projects, a search engine for students, and links to other science-related sites on the Internet. Sample links take students on a virtual scuba adventure; a virtual field trip to view dinosaurs at the Life Over Time Exhibit at the Field Museum of Natural History in Chicago, Illinois; and a visit to the Smithsonian Gem and Mineral Collection. A link to the Monterey Bay Aquarium home page features a section on commonly asked questions about fish and other marine creatures. At other sites, students can find information about volcanoes, take a quiz on the water cycle, or do science at home with Beakman and Jax. Winner, ENC Digital Dozen, January 1997. Magellan, 4 Stars. (Author/LCT) ENC-008735

Experimental Science Projects: An Introductory Level Guide

http://www.isd77.k12.mn.us/resources/cf/SciProjIntro.html

Grades 4-12

Author: David Morano
Publisher: Mankato State University

Visitors to this Web site can access both an introductory-level guide for doing a science project and an intermediate guide that contains additional material to help distinguish between different types of scientific studies. The intermediate guide also contains details about the experimental scientific method, and an introduction to experimental error. A sample science project is presented on the effect of salt on the boiling temperature of water. The project outlines the title, purpose, hypothesis, materials, procedure, experimental observations, results, conclusions, and further questions. Winner, ENC Digital Dozen, October 1995. (Author/DEB) ENC-004039

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v6n2-3

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Macintosh PC Other _____ I do not use a computer

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16*MB* 24*MB* 32*MB* 64*MB+* Do not know

How do you generally access the Internet?

I do not have Internet access
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modem - 28.8 kbps
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modem - 56 kbps or faster
cable modem
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TEACHER EDUCATORS, circle those grades for which you prepare teachers:

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